FEB 16 1959

PIPE LINE INDUSTRY

FEBRUARY
1959

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CONGRESS
SERIAL RECORD

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CONSTRUCTION REPORT
Europe's New Big-Inch Line on Stream 41

For a "Quick Look" at this issue, turn the page . . .

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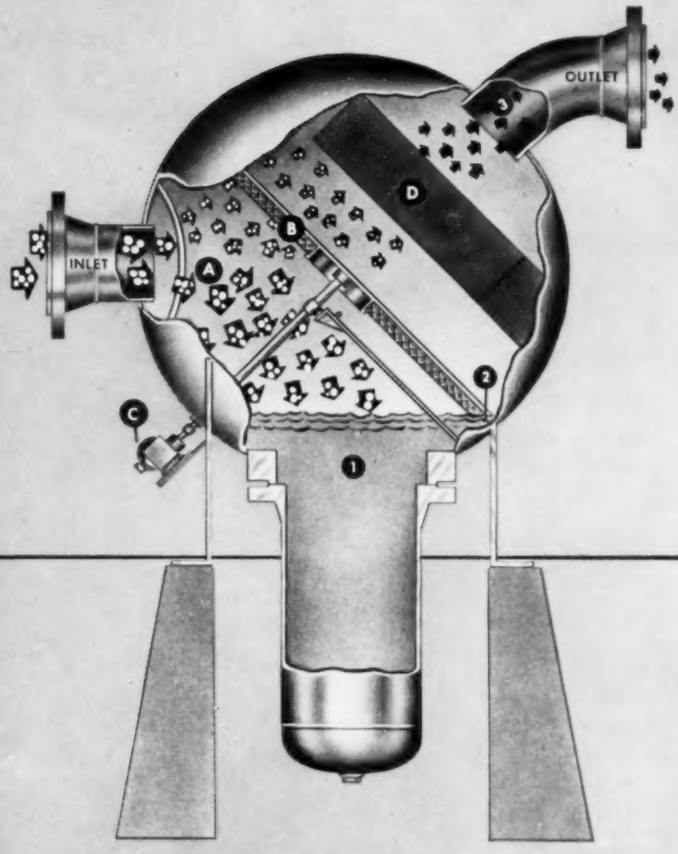
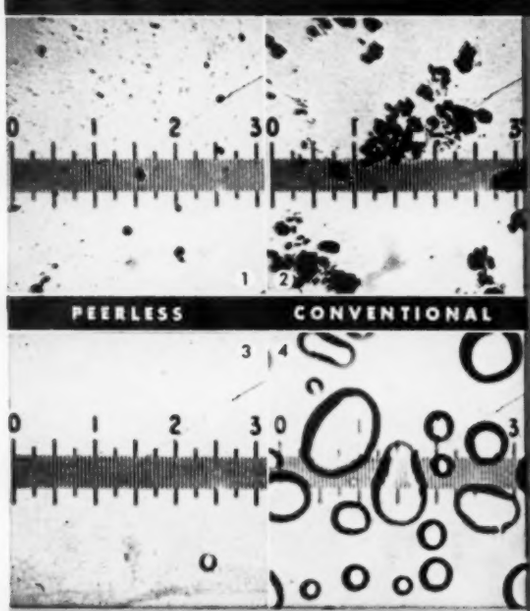
PEERLESS SCRUBOSPHERE*

*Spherical scrubber for dust and liquid removal from gas flow



LEGEND OF ABOVE CUTAWAY

The majority of incoming liquid (A) and solid particles are directed to either side and down into reservoir (1). Lighter solid particles carried by gas stream are separated on surfaces of contactor (B) which are kept wet and clean by revolving thru liquid reservoir (2). Contactor is revolved by explosion-proof gear motor (C). Mist Extractor (D) removes any remaining liquid particles from gas stream prior to outlet (3).



These photographs were made of microscope slides introduced downstream of the Scrubosphere and a conventional vertical oil bath cleaner under the same operating conditions. Plates 1 and 2 show the comparative amounts of iron oxide not removed with the amounts introduced being identical. Plates 3 and 4 indicate comparative oil loss with vapor rate through the vessels being the same.

LOOK AT THIS TEST The test at the left indicates the superiority of Peerless Scrubosphere over conventional oil bath dust scrubbers. The SCRUBOSPHERE operates with no loss of efficiency at low flows, minimum liquid loss, and very low pressure drop. Other outstanding features include easy vessel access with removable self cleaning contactor, a sump for slugs of solid or liquid particles, and minimum cost.

For detailed information write for Bulletin No. 180

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FEB 16 1959

PIPE LINE INDUSTRY

CONTENTS and Quick Look

February, 1959 gpc Vol. 10, No. 2

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

Effect of Entrained Liquids on Gas Measurement

☐ There is high interest with widely differing opinions on the role liquids play in orifice meter measurements of natural gas . . . both water and distillates. Here is a research report on some tests made with varying pressure, liquid-gas ratios, and meter run designs. Further studies may lead to a correction factor that would be practical in field measurement.

By Roy A. Schuster . . . . . Page 24

Spotlight on Hiring Hall Practices

☐ Contractors are showing growing concern over recent National Labor Relations Board decisions regarding union-contractor hiring hall procedures. These thoughts digested from an address by the NLRB general counsel should clarify the precautions in future agreements necessary to meet the requirements of the Taft-Hartley Act. . . . . Page 30

Saving Money With Mechanical Anchors

☐ This simple means of preventing pipe flotation is a bet that should not be overlooked by pipeliners contemplating water, swamp and wet terrain crossings. Mechanical screw-type anchors are inexpensive and their holding power is surprising. For example, it takes only 46 pairs of anchors to hold down a mile of 24-inch by .250 wall pipe in 90-pound mud. The cost: about $5,000.

By William Hollander . . . . . Page 35

Double Jointing Without Internal Pass or Tack Weld

☐ Improved line-up clamp, fiber glass tape back-up strip, "dogleg compensator" and floating welding head make for a completely external submerged arc welding process. Double joint weld is completed in five minutes with only two passes made in Bechtel's new plant.

By Donald D. De Pugh . . . . . Page 38

Europe's Longest Big-Inch Crude Line

☐ Northwest Oil Pipe Line Company's new 28-inch, 230-mile system features several innovations in construction and engineering. Modern methods were used in laying the system across German farms and a number of waterways; ideas borrowed from offshore drilling platform design were used in building the deep-water supertanker terminal nearly a half mile from shore at Wilhelmshaven.

By Omer Anderson . . . . . Page 41

Something New Has Been Added!

☐ Want to keep up with new ideas and developments that will affect pipelining in the future? If you do, then you'll be interested in the new feature starting in this issue. The author is none other than that fabulous character of the right of way, Pipe Line Pete! In this issue he points out some new developments that will have a tremendous effect on pipelining. Pete points out that one company is pulsing its cathodic protection system in the Gulf to open and close valves on platforms. Why not use the same procedure on land? For other interesting facts, read this new feature on . . Page 33

Automatic Yard Speeds Weight Coating

☐ A highly automatic asphalt-mastic heavy coating plant used new methods to increase production and achieve quality control on protective weight coating for submarine pipe lines. Southern Natural Gas Company and Brown & Root's new process produces highly cohesive weight coating . . . . . Page 44

Beware These Human Relations

☐ Sometimes human relations can be dangerous. Read about three common "fantasies" that can cause you serious personnel trouble . . . . . Page 47

Computer Aids for the Pipe Line Engineer—Part 2

☐ From a basic description of the flowcharts and their symbols presented in Part 1, this guide to computers goes into their use in logical operations. With this background, solutions to typical problems in pipe design properties and pressure drop calculations are explained.

By T. R. Young . . . . . Page 50

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The Blue Flame Grows Brighter

The sizzling hot competitive battle for the U.S. home energy market is scoring big gains for the oil and gas industry. Effective research, promotion and good service are paying dividends. Both gas and oil are showing healthy percentage increases; with the fastest growth being made by natural gas.

Here is the fuel trend picture in a nutshell:

1947: Coal provided 63 percent of the nation's heat—natural gas, 11 percent—oil, 23 percent.

1957: Coal provided 23 percent of the nation's heat—natural gas, 33 percent—oil, 44 percent.

Predicted for 1967: Coal will provide 5 percent of the nation's heat—natural gas, 47 percent—oil, 48 percent.

To sum up these statistics in a few words, the gains oil and gas have made on coal in the home heating market have been nothing short of phenomenal. However, while the oil industry was boosting its share of the market *70 percent* in the past 10 years, natural gas (starting from a much smaller percentage of the market) boosted its share *200 percent*.

The wide swath natural gas has cut into competing fuel sales has been no accident. Excellent promotional programs, plus intensive research to develop new uses for gas and to improve operations have added up to one of the most aggressive, highly competitive industries in the United States today.

American Gas Association President J. T. Wolfe aptly described the natural gas industry's progressive approach to modern competition with this statement: "Air conditioning research (in 1958) has carried five major projects forward to the prototype stage. A high-speed radiant oven and a greatly improved flexible gas connector are among the year's most important developments in the area of domestic gas research. In industrial and commercial gas utilization, dramatic progress was made in increasing food production capabilities and in the development of fry top sections and temperature control systems.

"Gas operations research in 1958 was highlighted by the development of processes to produce synthetic pipe line gas and formulation of a broad research program on distribution system problems. In pipe line research, we have developed methods of increasing gas deliverability from "drowned" wells, applied radioactive tracers to flow rate determination problems, and developed devices and techniques to reduce noise levels at compressor and regulator stations."

Further proof that natural gas is gaining in its competitive battle with oil is reflected in the following production figures:

1956: Crude production increased 5.3 percent to 2.6 billion barrels. Natural gas increased 7 percent to 10.1 trillion cubic feet.

1957: Crude production remained about the same at 2.6 billion barrels. Natural gas increased 6 percent to 10.7 trillion cubic feet.

1958: Crude production *decreased* 6.5 percent to 2.4 billion barrels. Natural gas increased 3.1 percent to 11.0 trillion cubic feet.

Of course, there were several factors influencing the above figures. Heavy production in the last quarter of 1957 to provide Western Europe with crude during the Suez crisis kept the total from declining during that year. The recession and excessive imports hit crude production much harder than natural gas during 1958, with the resulting drop in auto production and total demand for domestic crude and products.

But, natural gas also had its troubles during these years. Despite the slowdown in pipe line construction that resulted from the ill-fated Memphis Decision, natural gas production increased 3.1 percent last year. Also, revenues from gas utility and pipe line sales to ultimate customers soared to an all-time high of $4.6 billion, a gain of 10.6 percent over the previous record set in 1957.

To make the picture even more promising, there are no signs of a let up in natural gas industry growth. In fact, with no Memphis Decision holding back construction to provide service for millions of waiting customers, predictions are the natural gas industry will make a substantial increase over the record-breaking 32.1 million utility customers served in 1958, sales will reach a new high, and construction expenditures will reach $1.8 billion during 1959.

According to the American Gas Association, construction outlays for gas transmission, distribution and storage will total $8.1 billion for the four year period 1958-61, compared with $5.7 billion spent in 1954-57 and $5.1 billion in 1950-53.

The blue flame glows brighter and brighter—with no let-up in sight.

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PETROLEUM REFINER and THE REFINERY CATALOG for the oil, gas and petrochemical processing industry.

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Indexed by Engineering Index

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Gathering, distribution and transmission lines.. using Lone Star API line pipe..give trouble-free service month after month and year after year.

Every length of Lone Star pipe is subjected to the API hydrostatic tests in length of time and degree of pressure. Yes, Lone Star is rigidly quality-controlled from mining of ore to finished pipe. Lone Star fully normalized casing, tubing and line pipe are made strictly to Joe Roughneck's standards.

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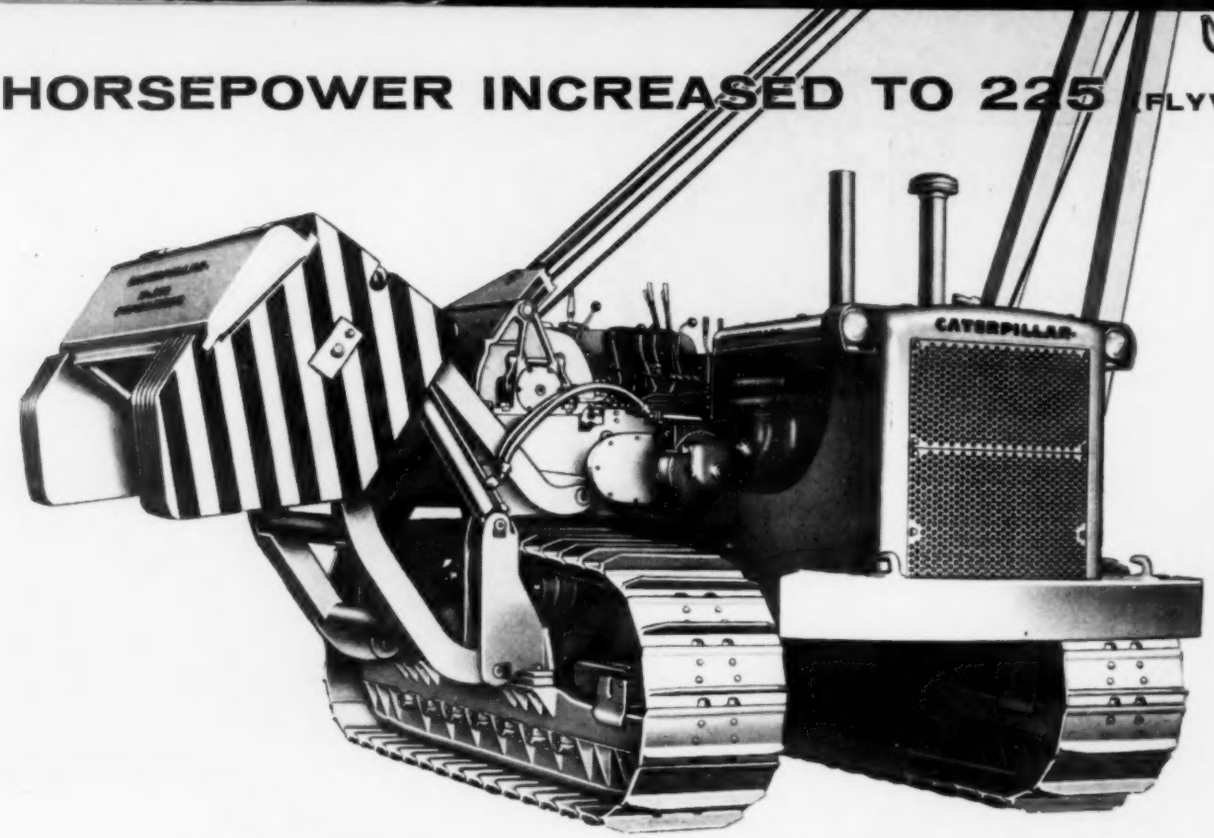
HORSEPOWER INCREASED TO 225 (FLYWHEEL)



CATERPILLAR'S
PROJECT PAYDIRT

PROJECT PAYDIRT pays off for you

NEW TURBOCHARGED

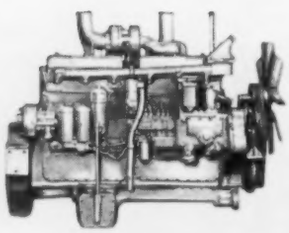
The Caterpillar No. 583 Pipelayer, the standard of spreads around the world, now is bigger, more powerful, more productive than ever. It's another major achievement in Caterpillar's all-out research program, "Project Paydirt" (see box below).

The strongest pipelayer of them all is completely new—in design, appearance and performance. It incorporates dramatic new engineering advances. It is easier to operate.

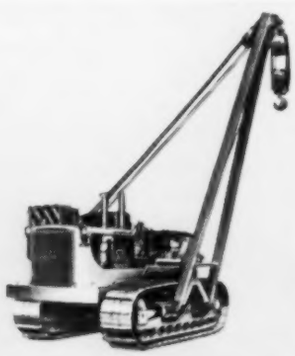
What will it do on your spread? Here's the answer:

The new No. 583 Series H has a lifting capacity of 137,000 lb.—an increase of 7,000 lb. Its counterweight suspension has been redesigned to make this possible.

No matter what terrain the pipe takes you through, ground clearance of the No. 583 is well known. Now with it comes greater stability. Tractor gauge has been increased from 86 to 90 inches. Ground contact, with 28-inch shoes, has been increased to 7,220 sq. inches.

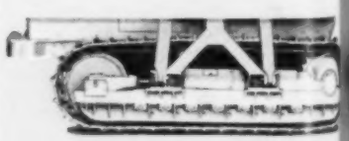


HORSEPOWER INCREASED 18%. The horsepower of the new No. 583 is up from 191 to 225 at the flywheel. In addition, over-all engine performance has been greatly improved by the addition of the efficient job-tested Caterpillar Turbocharger.



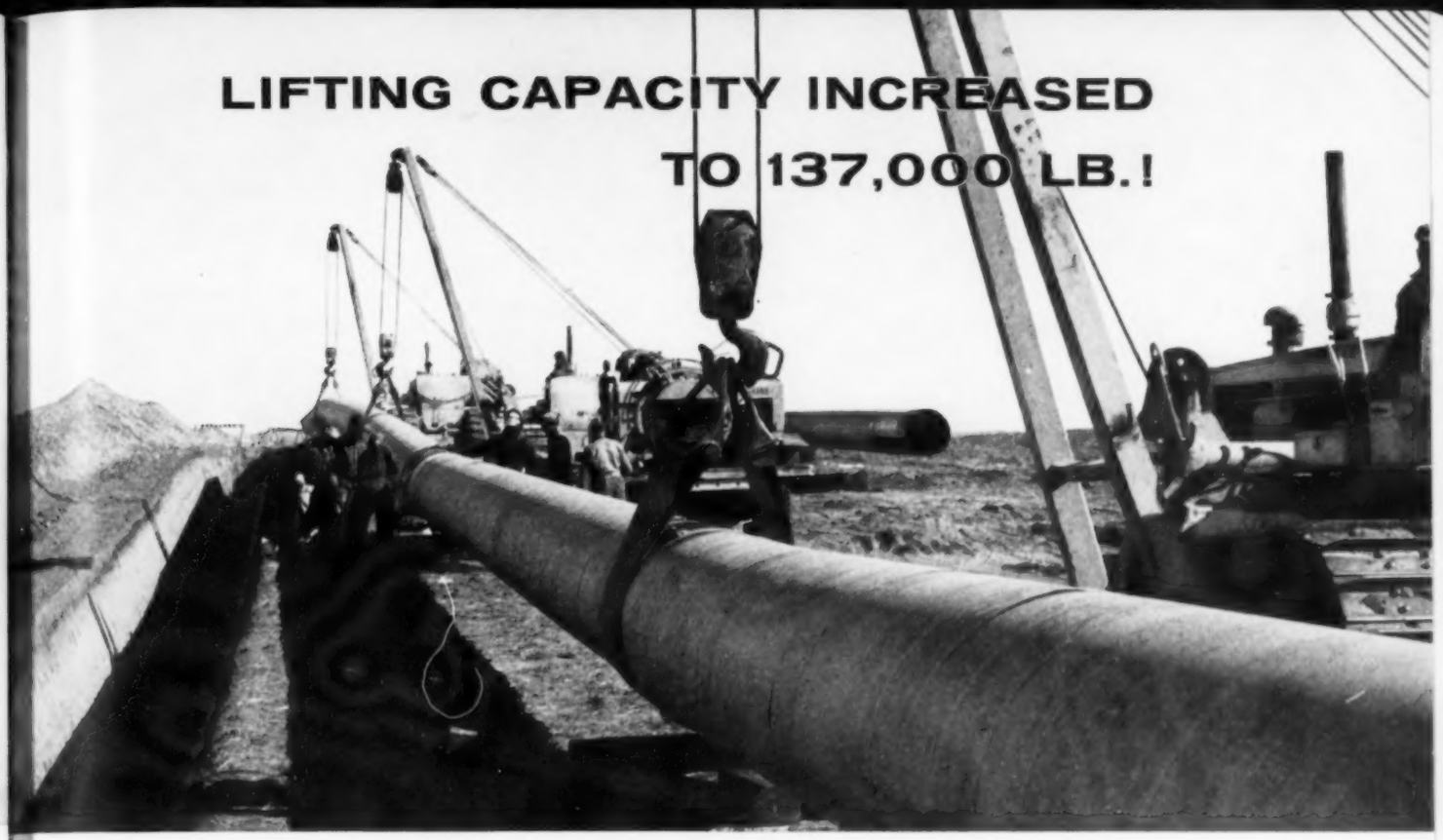
SIZE INCREASED. To make effective use of the new horsepower, over-all weight of the pipelayer has been increased 5,800 lb. to a total of 83,800 lb. Increased size means more lifting capacity. Capacity is now 137,000 lb.—an increase of 7,000 lb. In addition, counterweight suspension has been redesigned.

LIFETIME LUBRICATED ROLLERS AND IDLERS. That's right—lifetime! In a major research breakthrough, Caterpillar has achieved track and carrier rollers and idlers that never require further lubrication until rebuilding. And service life is hundreds of hours longer than with ordinary rollers.



NEW, STRONGER, HEAVIER UNDERCARRIAGE. Every component, such as frames, links, braces, pins, bushings, shoes, has been made stronger by the use of improved materials and heat treat processes to provide longer life. And 21 inches of ground clearance—a key feature—has been retained.

LIFTING CAPACITY INCREASED TO 137,000 LB.!



NO. 583 SERIES H PIPELAYER

These are only a few improvements on the new No. 583 Series H that will enable you to handle pipe faster. You will get higher production, yet the new machine is actually more economical to own and operate.

Find out for yourself. Get the full story from your Caterpillar Dealer, all the facts and figures that can only be touched on briefly here. Then see this great new machine at work on your spread as soon as possible.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

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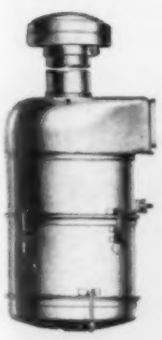
BORN IN RESEARCH... TESTED IN THE FIELD

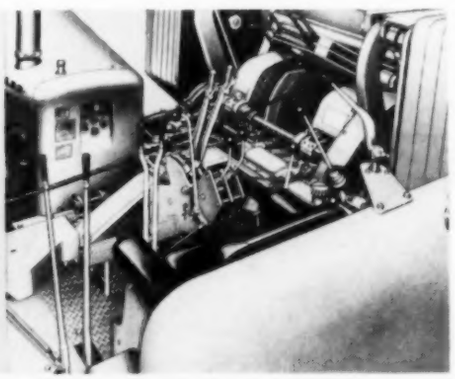
MINIMUM SERVICE NEEDS

Here are just a few of the new features that reduce maintenance time:

- Greater cooling capacity.
- Double-reduction final drive to extend life of transmission, bevel gear and pinion, steering clutches and brakes.
- Transmission, steering clutches and brakes get filtered, cooled oil under pressure for longer service life. A Caterpillar exclusive.
- No steering clutch adjustments are necessary.
- Transmission, bevel gear and steering clutches have a common lube system that uses engine oil.



DRY-TYPE AIR CLEANER. Another major Caterpillar research development on the new No. 583—the new dry-type cleaner removes 99.8% of dirt in the intake air even under severe operating conditions, means greater engine protection. The new cleaner can be serviced in 5 minutes, costs a good deal less to use.



SUPERIOR OPERATION. Pipelayer controls are conveniently located with "console" mounted levers for the winches. With this new control grouping, it's easy to get accurate cradling while maneuvering the machine. And operator visibility is even better than before because of narrower dash.

CATERPILLAR'S **PROJECT PAYDIRT**

PROJECT PAYDIRT: Caterpillar's multi-million-dollar research program to meet the coming challenge of the greatest construction era in history with the most productive machines ever developed.

why "Precisioneered"

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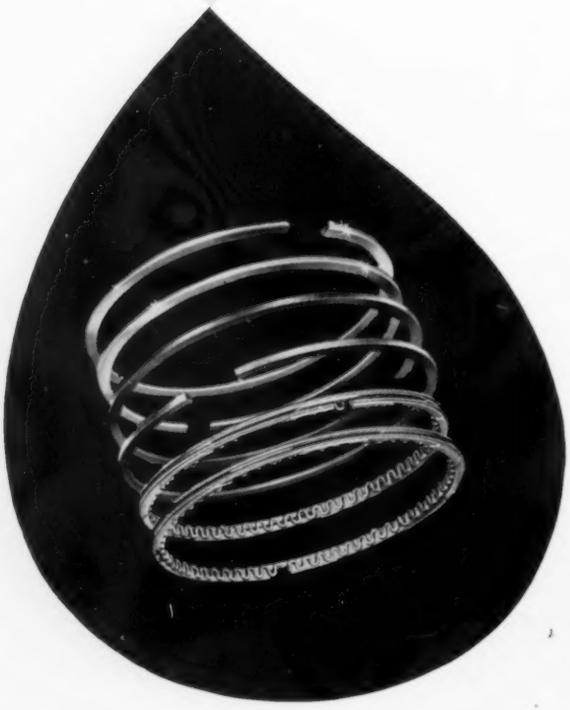

PEDRICK Piston Ring Sets for diesel and gas engines are "precisioneered" to assure maximum power with minimum oil consumption, to most effectively seal against blow-by, to deliver the greatest number of hours of efficient performance at lowest operational and maintenance costs.

The rings in a PEDRICK "Precisioneered" Set are individually designed to assure users coordinated *team* action. The assembled set is tailor-made for *unitized* action in the specific engine.

That's why PEDRICK Engineered Sets are used as original equipment in practically all leading heavy-duty diesel and gas engines . . . and why when replacement rings are installed, PEDRICK Engineered Sets are specified by most maintenance men.

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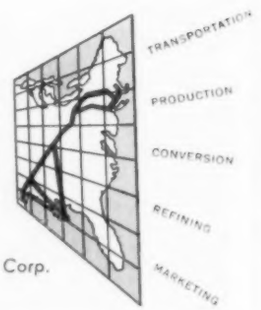
Only a boy. But his thoughts are far in the future. Thinking, dreaming, his mind sees more than his eyes do. So with all boys... or business. Vision, looking beyond the commonplace, finds new things to do or make.

In our own industry, for example, natural gas and oil blend with imagination to produce an endless stream of new products and processes.

New ideas and ways of doing that make life more agreeable for all Americans.

From natural gas and oil . . . heat, power, petrochemicals that mean ever wider service to man.



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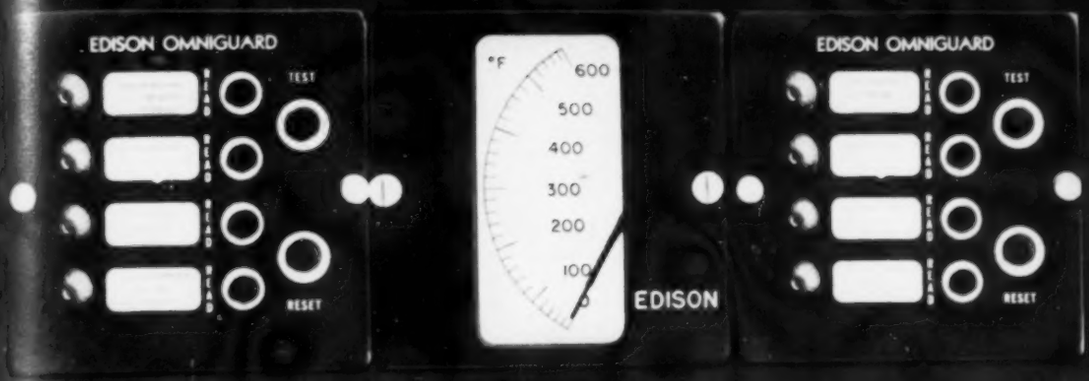
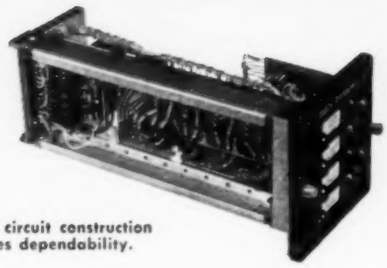
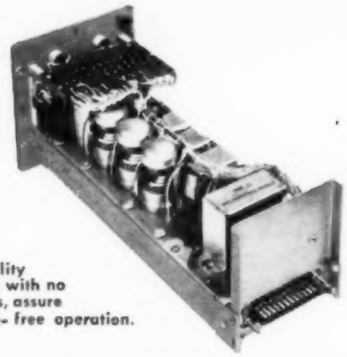


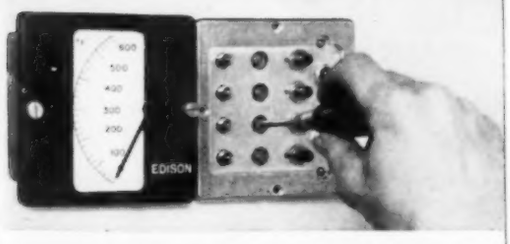
Model 310 Edison Omniguard with Model 311 Indicator — a single indicator can read any number of temperature points.



Printed circuit construction increases dependability.



Highest quality components, with no moving parts, assure maintenance-free operation.



Easy access to all components permits quick temperature settings and monitoring system changes – at any time.

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new model 310 omniguard temperature monitor... unmatched for versatility

The new Model 310 Edison Omniguard provides the simplest, most dependable temperature detection system yet devised... for both small and large installations.

The Omniguard system is reliable... flexible... economical. You order only the plug-in units needed, add new units as your monitoring needs expand.

Check these features of the new Edison Omniguard:

1. VERSATILE: One instrument can be used for both normally open and normally closed annunciator... for alarm or for shutdown of equipment.

2. FLEXIBLE: Quick, inexpensive system changes and additions . . . easy tie-in with any type annunciators or cut-off switches.

3. DEPENDABLE: Rugged design with highest quality components, no fragile moving parts.

4. SIMPLE: Single indicator reads any number of temperatures, needs no periodic adjustment. With a minute's briefing, *anyone* can operate the simple Omniguard monitoring system.

5. LOW COST: Plug-in units can be custom-tailored to your exact requirements . . . order additional units only when needed.

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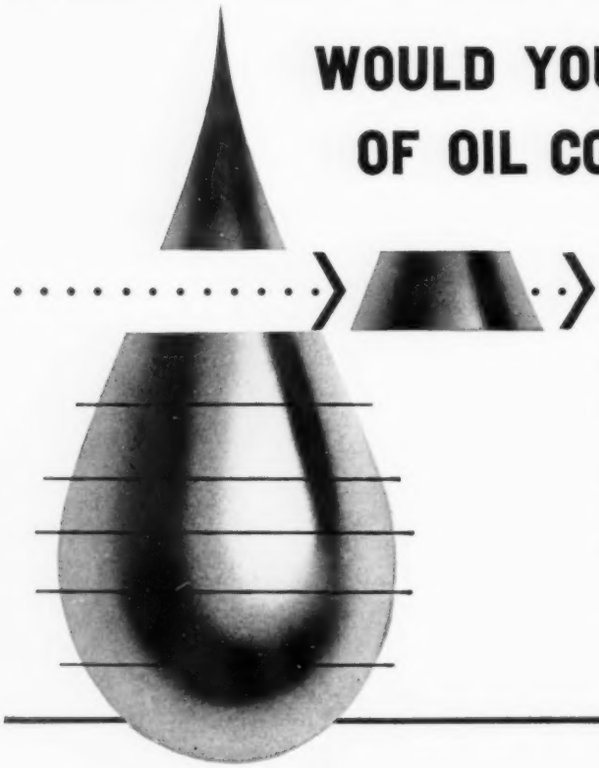
NEWS YOU CAN USE ABOUT ENGINE AND COMPRESSOR PERFORMANCE



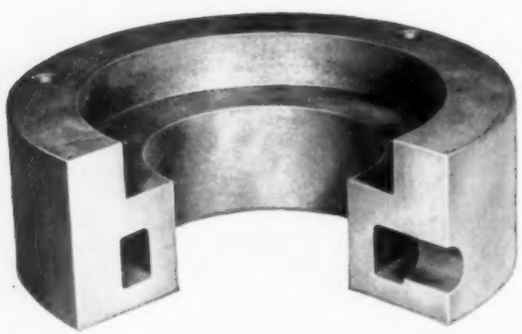
WOULD YOU BELIEVE THAT ONE DROP OF OIL COULD BE THIS IMPORTANT?

Take a 12 cylinder, 2,000 HP, 330 RPM engine . . . let just **ONE-EIGHTH OF A DROP** of additional oil per stroke be used in each cylinder and here's what will happen: your oil consumption rate will increase from 8000 BHP hours per gallon to 2000!

And that's the big reason Cook rings save you money. Like other oil control rings, Cook rings meter oil and properly spread it, but Cook rings do this in addition: *they prevent excessive use of oil!*

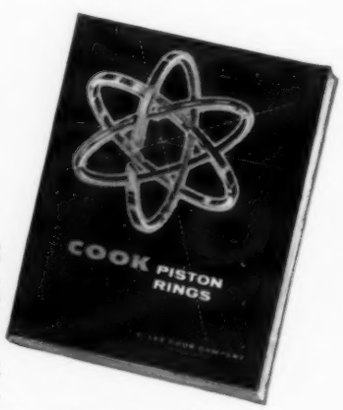
Don't just get oil wiper rings . . . get Cook *engineered* conformable oil wiper rings, the most copied oil control rings in the world!

KEEPS PACKING COOL . . . AND IT'S LEAK-PROOF!



Cook's new leak-proof packing cup features circulating water completely *inside of the cup itself* . . . eliminates any possibility of leakage, corrosion or contamination of the material under compression. These are big advantages for all applications—and are naturally of even greater importance on non-lubricated service.

WRITE FOR COOK'S NEW PISTON RING CATALOG

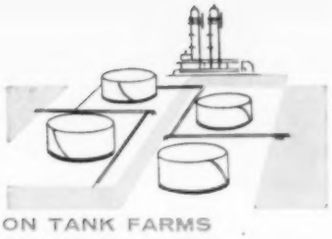


Sixteen-page catalog just off the press. Describes complete line of piston rings manufactured by C. Lee Cook Company, also the special rings of the Airtomics Division. For your free copy, write: C. Lee Cook Company, 944 South 8th Street, Louisville 3, Kentucky.

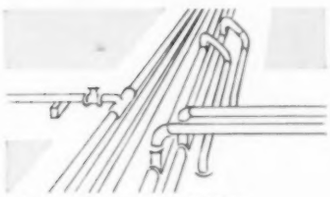
C. LEE COOK COMPANY

Division of Dover Corporation

Rings and Packings Since 1888



ON TANK FARMS



AROUND PIPELINES

AT WELL SITES

stop weeds and fires before they start

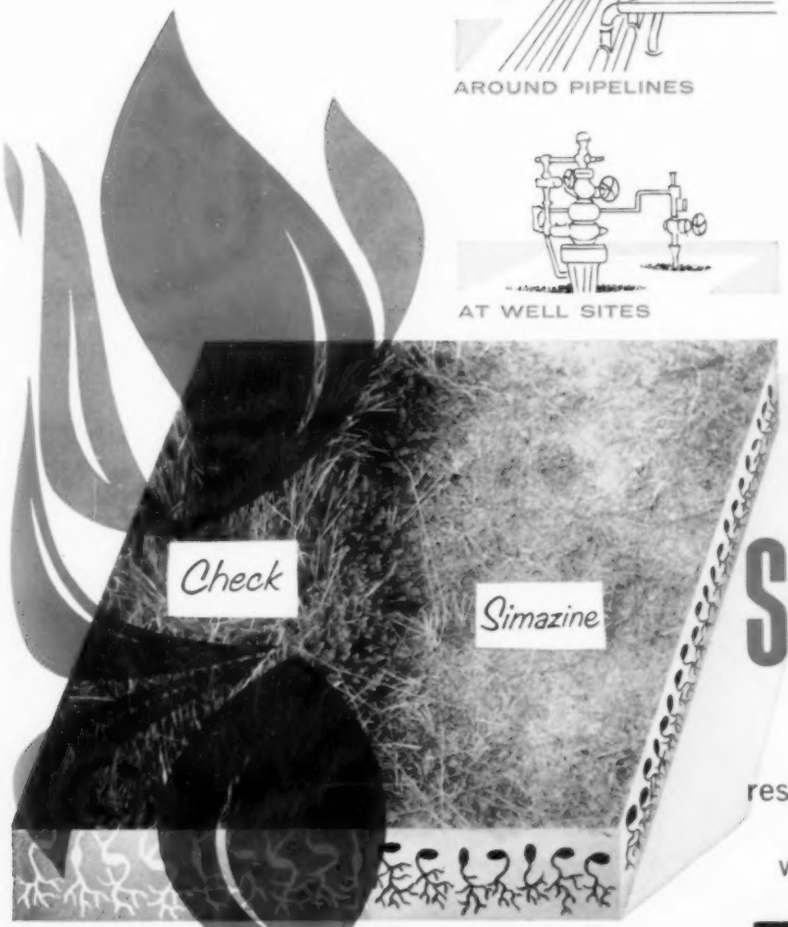
get preventive weed control with

GEIGY

SIMAZINE* 50W

pre-emergence residual herbicide with

7 SAFETY FEATURES



Weed control is an old problem to the petroleum industry. Now Geigy's pre-emergence herbicide Simazine 50W provides a new and better solution – makes weed control *easier* because it is long residual; *safer* because of its Seven Safety Features; and *more effective* because it stops weeds before they start.

ONE APPLICATION PER SEASON

At the rate of 20 lbs. per acre, one pre-emergence application of Simazine 50W controls most annual broadleaf weeds and grasses for an entire season. For longer residual control, or for control of more resistant perennials, use 30 to 40 lbs. per acre.

SEVEN SAFETY FEATURES

Oil maintenance men especially appreciate Simazine 50W's Seven Safety Features. This new herbicide is safe to humans and animals, non-flammable, non-corrosive, non-abrasive, and presents no conductivity problem or drift hazard. Check the panel for these and all of Simazine 50W's Seven Safety Features – and compare.

TECHNICAL SERVICE

Geigy Technical Service is readily available to serve you. Write for additional information, the name of your nearest Simazine 50W distributor, or ask to see a Geigy technical representative. Address: Geigy Agricultural Chemicals, P.O. Box, 430, Yonkers, N. Y.

1. **SAFETY TO HUMANS AND ANIMALS**
   Extremely low toxicity. No need for protective clothing.
2. **SAFETY TO ADJACENT VEGETATION**
   Minimum lateral leaching. Remains where it is applied.
3. **SAFETY TO SPRAYING EQUIPMENT**
   Non-corrosive or abrasive to equipment.
4. **SAFETY NEAR ELECTRICITY**
   Relatively low electrical conductivity.
5. **SAFETY FROM DRIFT HAZARD**
   Works through roots – little or no toxicity to foliage.
6. **SAFETY FROM FIRE HAZARD**
   Non-flammable. No application hazard.
7. **SAFETY ON VALUABLE LAND**
   Not a permanent soil sterilant.

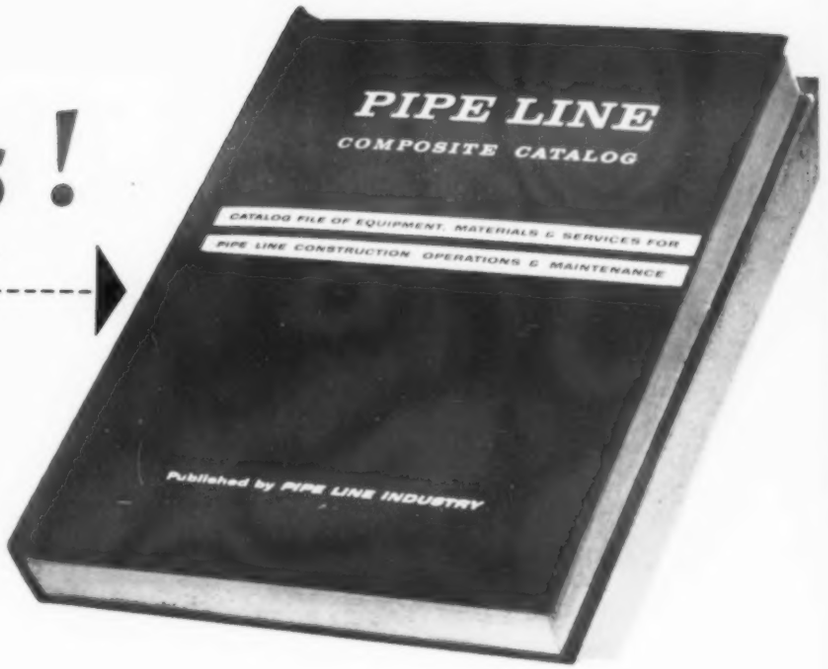
ORIGINATORS OF Geigy DDT INSECTICIDES

* "SIMAZINE" is a trademark of Geigy Chemical Corporation

GEIGY AGRICULTURAL CHEMICALS • *Division of Geigy Chemical Corporation* • Saw Mill River Road, Ardsley, N. Y.

where's the **WIDGET?**

Here it is !

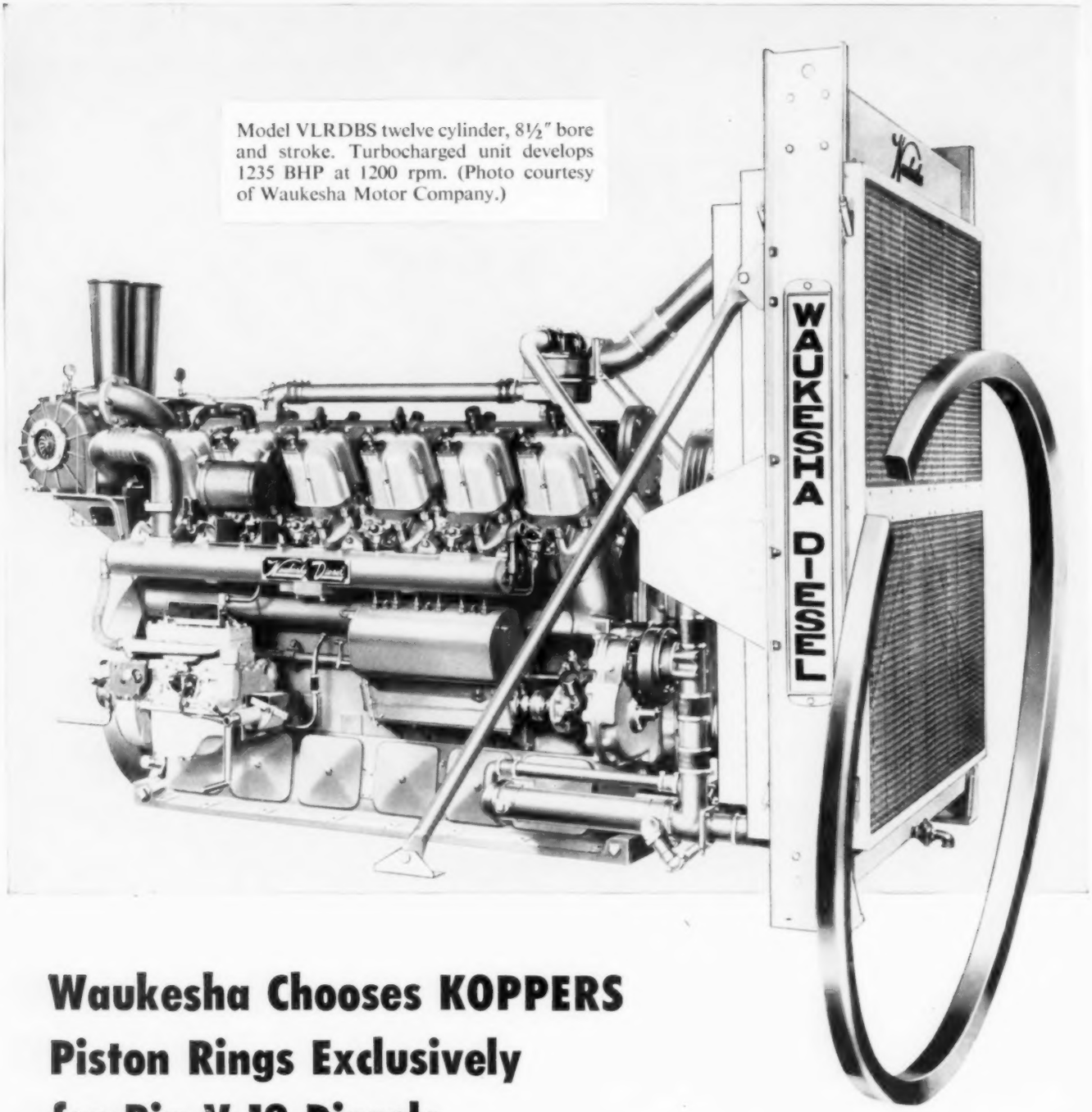

PIPE LINE
COMPOSITE CATALOG
CATALOG FILE OF EQUIPMENT, MATERIALS & SERVICES FOR
PIPE LINE CONSTRUCTION, OPERATIONS & MAINTENANCE
Published by PIPE LINE INDUSTRY

. . . along with 11,148 other pipe line equipment and service items, cataloged, indexed and cross-referenced in the only comprehensive data file published specially for the pipe line industry PIPE LINE COMPOSITE CATALOG is preferred 8-to-1 over individual company literature by the men who buy and specify in this market. That's why 147 suppliers and service organizations placed their complete or condensed catalogs in this one-volume reference in 1957.

The next time *you* compare, buy or specify pipe line equipment or services, look *first* in PIPE LINE COMPOSITE CATALOG. Chances are you'll save time and money.

PIPE LINE COMPOSITE CATALOG

***Published by* PIPE LINE INDUSTRY**



Model VLRDBS twelve cylinder, 8½" bore and stroke. Turbocharged unit develops 1235 BHP at 1200 rpm. (Photo courtesy of Waukesha Motor Company.)

Waukesha Chooses KOPPERS Piston Rings Exclusively for Big V-12 Diesels

Waukesha's VLRDBS supercharged diesels are perfectly suited for applications such as oil rigs, excavators and tugboats where a surge of reserve power is essential for emergency and overload demands.

This recent series of diesels manufactured by the Waukesha Motor Company, of Waukesha, Wisconsin, is designed to develop tremendous power under the severest operating conditions . . . the kind of power that puts a premium on piston ring performance. Waukesha has selected Koppers Piston Rings as have other manufacturers who must be certain of reliable component performance.

This dependability is yours when you rely on Koppers with their complete range of materials . . . wide selection of types and sizes . . . rigid quality control and careful inspection. These factors contribute to Koppers unchallenged leadership in producing the finest piston and sealing rings for industry.

Instead of undergoing needless expense in solving ring problems, take advantage of Koppers experience, research facilities and craftsmanship. Write for information today. KOPPERS COMPANY, INC., Piston Ring and Seal Dept., 4602 Hamburg St., Baltimore 3, Md.

★ **KOPPERS DEPENDABLE RINGS CONTRIBUTE TO WAUKESHA'S RELIABLE PERFORMANCE UNDER THE MOST RUGGED CONDITIONS.**

KOPPERS

AMERICAN HAMMERED
Industrial Piston Rings
Engineered Products Sold with ***Service***

Introducing the

Newman-McEvoy

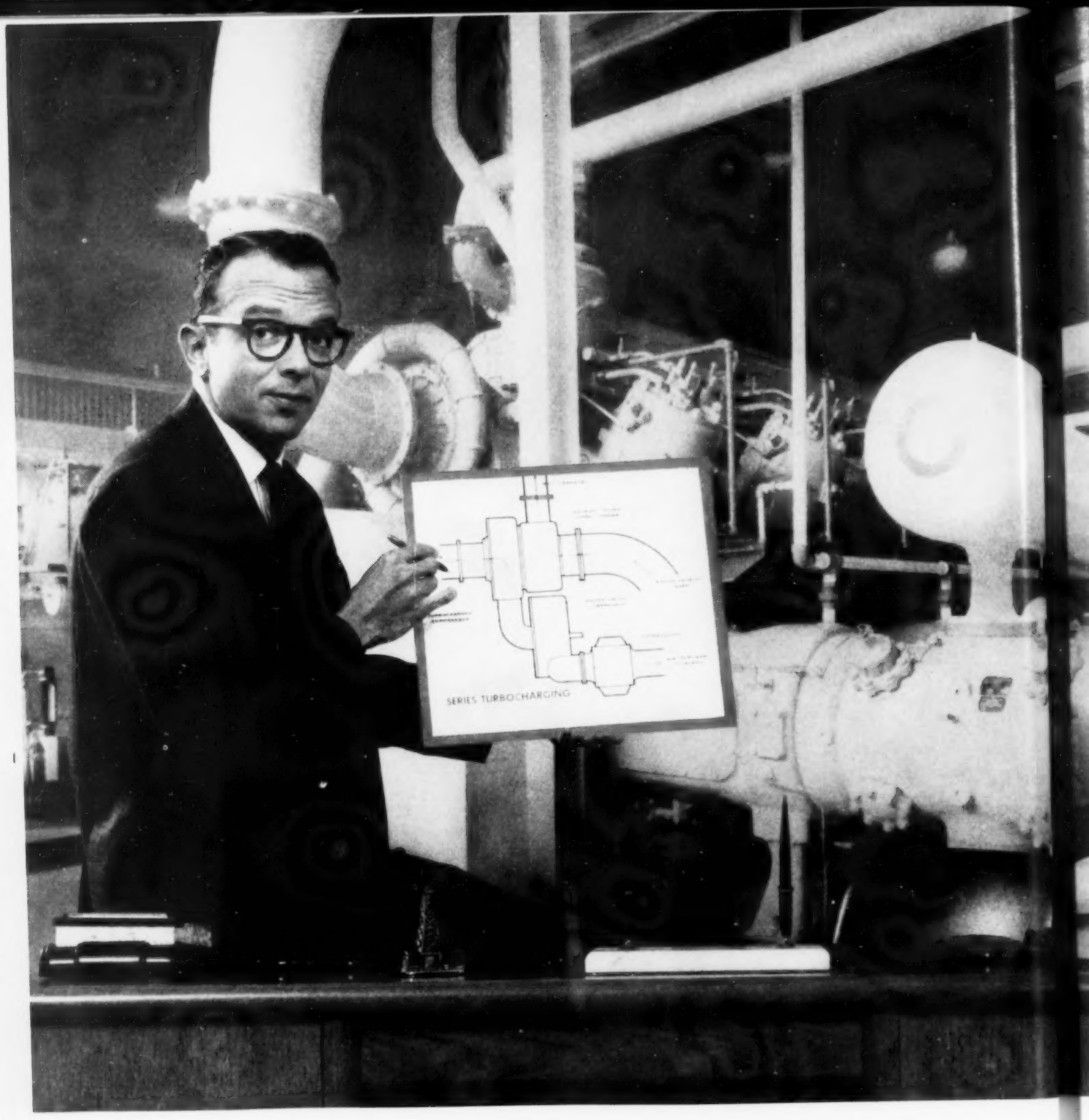
PIPELINE VALVE

The only automatic self-sealing conduit gate valve. Manufactured in sizes (both full bore and venturi) from 8″ to 36″ inclusive, Classes 300, 400, 600 and 900. Our technical experts are at your service on any questions of application.

The small sizes of Newman-McEvoy Valves have proved their merit under the severest conditions. Now these larger sizes, employing the same time-tested, self-sealing principle, are being made after a most rigid series of tests covering all possible conditions of pipeline service.

NEWMAN, HENDER & CO., LTD. WOODCHESTER, STROUD, GLOS. ENGLAND.

Telephone: NAILSWORTH 360 (6 lines). Telex: 43-220. Telegrams: Valves, Telex, Stroud.



Built Entirely By Cooper-Bessemer. Cooper-Bessemer is able to ideally integrate turbocharger system and compressor engine performance . . . and to assure highest standards of materials and workmanship for these precision components.

Donald L. Reed, *Manager Gas Engine Compressor Sales, The Cooper-Bessemer Corporation, explains . . .*

How you get 40% more power with the latest Cooper-Bessemer V-Angle Compressors

The diagram explains Cooper-Bessemer's series turbocharging development. A step beyond ordinary turbocharging, *series turbocharging* assures an extra performance margin throughout the operating range, plus these unmatched advantages:

40% greater horsepower than predecessors of the same bore, stroke and speed.

Reduced fuel consumption . . . as low as 6900 Btu/bhp/hr—proof of series turbocharging's greater efficiency.

Space savings. Greater output, combined with inherent compactness of V-angle design, results in lowest cost per horsepower for housing, foundation, piping, maintenance, supervision.

Superior altitude performance. Inherent flexibility of the series turbocharging system allows unique altitude compensation to assure full rated horsepower and highest efficiency.

Full range response. The Cooper-Bessemer series turbocharging principle *automatically* provides optimum supercharging regardless of the degree of load.

WRITE FOR BULLETINS . . . complete details on Cooper-Bessemer Series Turbocharged V-Angle Compressors in GMVC Bulletin 85 and GMWC Bulletin 86. Free on request.

Latest Bulletins. GMVC Bulletin 85, 1100 to 1800 bhp; GMWC Bulletin 86, 2000 to 3500 bhp.

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Tuffy® Tips On

SAFE USE OF SLINGS AND HOIST LINES

Lifting Strains Take High Toll of Injuries

Did you know that in some states one in every six compensation claims involves back injuries? And that one insurance company says back injuries constitute 60% of their claim expense?

Hernia is another hazard of materials handling. One manufacturer reported 75% of his compensation claims involved hernias. This high incidence of hernias and back injuries can be greatly reduced by proper lifting equipment and methods.

What can you do to reduce materials handling accidents? Here are some of the answers:

1. Teach your workers rated load factors. Warn them not to overload slings.

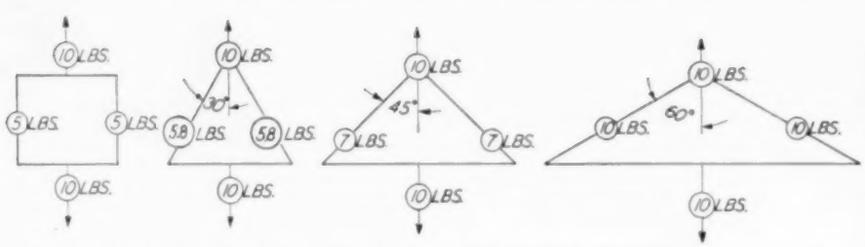
2. Use the right size hoist for every heavy lifting job. Don't put the load on human muscle.

3. Show workers how to rig hoists properly and safely. Load chains shouldn't be used as slings. Previous distortion and weakening of links may cause them to break even with a light load.

4. Inspect hoist load brakes often. Slipping or dragging brakes should never be used.

5. Be sure to use the proper sling for the job. Don't assume that all slings made of wire rope are right for all lifting operations.

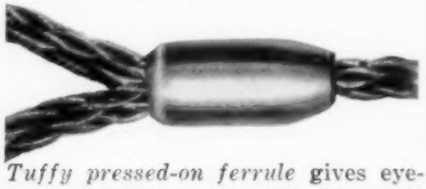
How Sling-Leg Load Increases with Increased Fleet Angle



These four drawings show approximate load increases on each leg of a bridle sling as the vertical angle of spread between legs increases. For accurate factors for the various angles, refer to your Tuffy Sling Handbook. (Don't have one? Write Union Wire Rope Corporation. Specialists in high carbon wire, wire rope, braided wire fabric and stress relieved wire and strand. 2278 Manchester Avenue, Kansas City 26, Missouri.)

Why Tuffy Slings Do A Better Job More Safely

Tuffy Slings have a combination of extra strength and super flexibility. The patented machine-braided fabric is the secret. It gives Tuffy greater strength, faster handling, longer life, greater safety than ordinary slings—at a cost to service life ratio that figures low. And it's so flexible that kinks can be pounded out without material damage.



Tuffy pressed-on ferrule gives eye-splice full fabric strength. The steel ferrule is applied under tremendous pressure. It literally flows into spaces between wires and strands. The friction force thus created gives the eye-splice 100% of the fabric strength. And the streamlined Tuffy ferrule leaves no openings or rough projections to snag or injure hands.

Tie a knot in a Tuffy Sling? Pull it as tight as you can. Even if you kink it, it's still easy to straighten out with no material damage to the sling.

See Your Tuffy Distributor

He's stocked for fast delivery of all your Tuffy Slings and Union Wire Rope needs.

Get Your FREE Tuffy Sling Handbook

Gives full data on Tuffy Slings. Types, dimensions, weights and rated loads. Also contains an expanded section on fittings — many not previously shown. Write for your copy now.

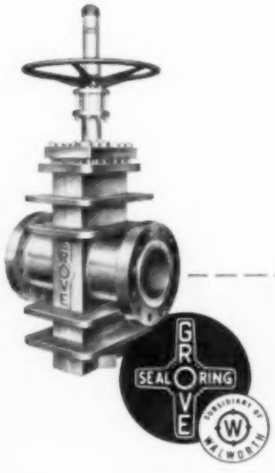
UNION Wire Rope

ARMCO

Subsidiary of ARMCO STEEL CORPORATION

OTHER SUBSIDIARIES AND DIVISIONS: Armco Division • Sheffield Division • The National Supply Company Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Southwest Steel Products

.....wipe out the need for lubrication



Lubrication problems are wiped out with the squeegee action of the exclusive Grove Seal-O-Rings. Up or down movement of the gate through the floating seats cleans and polishes both upstream and downstream surfaces. Foreign matter which could cause sticking, distortion, or abrasion is removed. The "O" Rings provide smooth action through the seats and bubble tight pressure seals on both sides of the gate. Specify Grove Seal-O-Ring Gate Valves. When they're set you can forget about lubrication or sealing compounds forever.

Grove valves never require lubrication

GROVE VALVE & REGULATOR COMPANY

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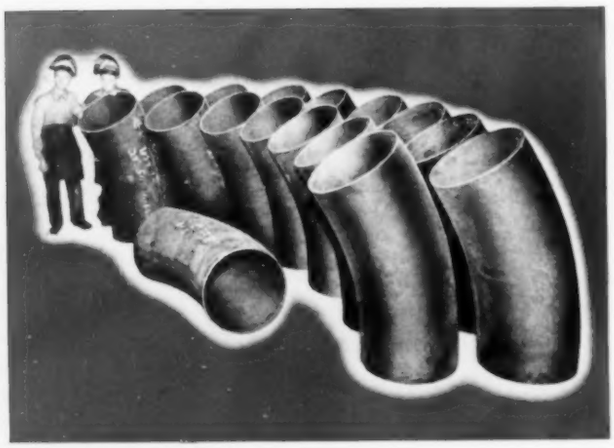
For more data on advertised products, use Readers' Service Cards, last page.

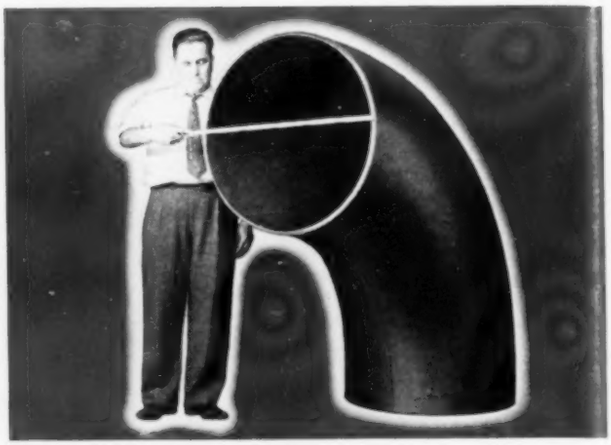
MIDWEST PIPELINE WELDING FITTINGS

SAVE TIME . . . CUT COSTS . . . SOLVE PROBLEMS



CONTOUR ELBOWS

Originated by Midwest and available in 22", 24", 26" and 30" sizes. Angles 10°, 15°, or 30° with 3D radius, providing a long sweep for easy pipe cleaning. 8' tangent at each end removes weld from highly stressed curved section and facilitates alignment. Uniform concentricity permits smaller angles to be obtained by cutting elbow. Available in various wall thicknesses of carbon steel, high yield and low alloy materials. Write for data sheet.

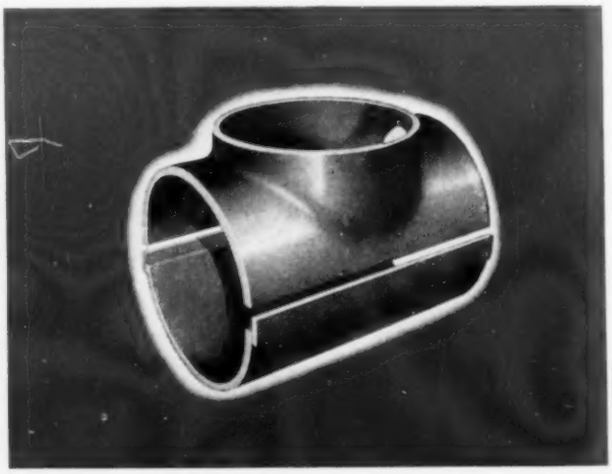


LONG TANGENT ELBOWS

Cost no more than ordinary elbows and are available up to 36" OD in wide variety of materials and wall thicknesses. Tangent at each end equal to ¼ nominal pipe size up to 24" OD—all larger sizes have 6" tangents. These added straight ends save pipe and often eliminate short nipple and extra weld; they remove circumferential welds from point of greatest stress . . . make lining up easier, save time and expense in welding. Write for Catalog 54.

REDUCING ELBOWS

Takes the place of straight elbow and reducer, thus saving one weld, requiring less space and reducing turbulence of flow. Stock sizes available up to 30" OD and in reductions to one-half of large diameter. Being fabricated from plate, it can be made in special thicknesses and materials. Write for data sheets.



WRAP-AROUND SADDLES

"Complete encirclement" type of welded branch reinforcement for making hot taps is available with or without welding strap and from carbon steel or high yield materials. In addition to fitting shown, other types illustrated in Section 8 of ASA B31.1 are available. Write for Data Sheet No. 20.

CAP SADDLES

Reinforcement for nozzle connection into cap. Available in sizes up to 24" on 36" in carbon steel and high yield materials.

Recognizing the fact that conventional welding fittings do not always best meet pipeline needs,, Midwest some years ago began the development of special fittings. These are designed for a specific job . . . to save time, cut cost and improve pipelines. The unique Midwest method of manufacture makes the use of special materials easy, economical and permits better delivery . . . it also often enables us to improvise to exactly meet unusual conditions. Write us regarding your requirements.

MIDWEST PIPING COMPANY, INC.

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7676

PIPE LINE PANORAMA

Remote Valve Control with Pulsed Cathodic Protection? . . . Major company is now field testing this promising method for remote operations in the Gulf of Mexico. Although still in experimental stage, early reports indicate valves can be opened and closed on distant platforms by simply pulsing protection current impressed on underwater lines. Method might also apply to onshore pipe lines. (See Page 33 for new monthly feature reporting on new ideas and developments to watch in the pipe line industry.)

FPC Considers Major Pipe Line Projects . . . Michigan-Wisconsin Pipe Line has received temporary green light to build 352.9 miles of 14-inch line loops and 16,560 hp extra compressor capacity in Kansas, Missouri, Iowa, Illinois and Michigan.

Hotly contested, lengthy hearings on Midwestern and parent company Tennessee Gas Transmission proposals to provide waiting Midwest customers with natural gas will resume February 16. Midwestern wants to construct 350-mile, 30-inch gas line from Portland, Tennessee to Joliet, Illinois, for the Chicago-Gary market. TGT plans to lay 157 miles of 36-inch loop lines in Louisiana and Mississippi, and install additional 114,900 hp compressor facilities in Texas, Louisiana, Mississippi and Tennessee.

FPC hearings on Transwestern's application to construct 1,809-mile gas system from West Texas to California will resume April 13. Line would supply 350 MMcf daily to western markets.

Pacific Gas Transmission has filed FPC application to construct 614-mile section (from U.S.-Canada border to Oregon-California border) of 1,300-mile, 36-inch gas line from Canada to San Francisco Bay area. Also, Pacific Gas and Electric has asked California Public Utilities Commission for go-ahead to build 296-mile portion in California. If and when both requests are granted, $333 million line will provide 420 MMcf of gas daily from Alberta to California markets.

Radioactive Tracers Test Line Flow . . . Panhandle Eastern, in cooperation with American Gas Association and Institute of Gas Technology, has completed industry's first operational flow efficiency test using radioactive material as tracer. Argon 41 gas was used as tracer because its molecular properties will not permit radioactive contamination of substances it contacts—and radioactive half-life of Argon 41 is so short gamma rays decay and disappear in a few hours, thus eliminating health hazards.

One reason for test was to compare Argon and anhydrous ammonia as tracers. Result: Negligible difference between calculated flow efficiencies when using ammonia or Argon.

Mikoyan Was Wrong Again . . . Despite Premier Mikoyan's statements otherwise, U.S. company's recent request to ship 12,000 tons of 28-30 inch line pipe to Russia received emphatic thumbs down treatment from Commerce Department. Reason: U.S. government has strict policy which prohibits shipment of pipe more than 24 inches in diameter to Iron Curtain countries.

Natural Gas Industry to Set New Records in '59 . . . Industry will spend $1.7-$1.8 billion in '59 for construction and development of gas transmission, distribution and storage (See Page 4). Prediction: Construction outlays will total $8.1 billion in '58-'61 period, compared with $5.7 billion spent in '54-'57 and $5.1 billion in '50-'53.

Effect of Entrained Liquids On Gas Measurement

These tests with water and distillates at varying rates of flow, pressures, gravity, and meter sizes may provide a practical correction factor for field use

By Roy A. Schuster
Texas College of Arts and Industries, Kingsville, Texas

IN MEASUREMENT of natural gas by orifice meter all of the factors used in the calculation of flow are based on the assumption that the gas is dry. This condition is rarely the case in field measurements. Tables in the AGA Committee Report No. 3,[1] recognized as an industry standard, give no data regarding the effect that a liquid may have upon gas measurements by orifice meter. Effect of mechanically entrained liquid which may pass through the orifice as a mist is a subject of considerable conjecture.

It is this area of measurement that has been made the subject of this investigation.

Orifice meter measurements indicate that an erroneously high differential pressure may occur when a fluid in the liquid phase is commingled with a fluid in the vapor phase being metered.

It was believed that if the effects of a liquid upon gas measurement could be determined accurately, a correction factor could be calculated: a curve could be drawn plotting the percent error against the liquid content in applicable terms, such as barrels of water per million cubic feet of gas. Then, if the liquid content was known, the percent of measurement error could be obtained from the curve: the recorded volume could be adjusted to more accurately indicate the true volume.

Although it was known that the percent error became larger when a larger volume of liquid per unit of volume of gas was present, it was decided to investigate the effects when a small volume of liquid (5 to 10 barrels per million cubic feet) as well as the larger volumes. This error would undoubtedly be small, so the actual correction in gas volume would be inconsequential on small quantities of liquid. Nevertheless, it could be significant where very large volumes were involved.

Full Range of Tests. It was decided to use full scale orifice meter installations, in 3-inch and 4-inch sizes, and run a series of tests to determine if a correlation could be established between dry gas measurement and varying amounts of liquids with regard to true measurement. Tests were to be run at various liquid rates, liquid specific gravities, gas rates and pressures, as well as different orifice plate sizes.

Effect of the velocity of approach to the orifice plate upon the indicated differential pressure has also been considered. A 3-inch and 4-inch meter run was installed in series to determine what affect, if any, the change in velocity might have upon measurement.

Description of Apparatus. The location chosen for the test was a plant which operated gas systems at two different pressures: one at 1,000 pounds per square inch and one at 600 psi. Inlet separators for the removal of liquids were installed on both systems. For running the tests, gas was taken from the 1000-pound pressure system, passed through the test meters, and into the 600-pound pressure system.

Pressure for running the tests could be varied from approximately 600 pounds to 1,000 psi. Also, water was available at 1,000 pounds pressure; its composition was constant. Water storage capacity of the separator was sufficient to permit varying the water rate over a large range.

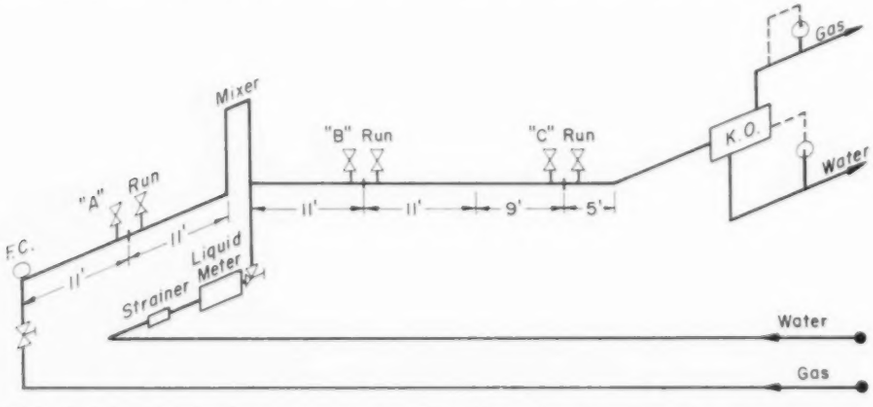

FIGURE 1—Sketch of test apparatus used to determine the effect of varying amounts of water in the gas stream. Meter run "A" is a 4-inch run used to measure the dry gas. Water was measured by an orifice meter and mixed just upstream of the "B" run which was a second 4-inch meter run used to obtain test results. Run "C" is a 3-inch meter run used to check results. Water was knocked out downstream of run "C".

Three Meter Runs Used. Physical equipment consisted of three meter runs in series. Residue gas from the 1,000-pound plant inlet separator was first passed through a 4-inch meter run, Run A, which measured the dry gas. Water was taken from the inlet separator, passed through a strainer and liquid meter, and mixed with the gas at the outlet of Run A in a liquid loop. This two-phase stream was then passed through another 4-inch meter run, Run B, and then through a 3-inch meter run, Run C. After passing through Runs B and C, the stream then went through a water knock-out tank where water was removed and dumped to drain. Gas

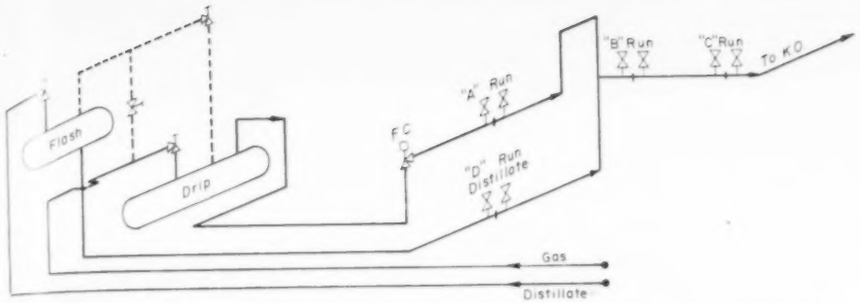

FIGURE 2—In the distillate test apparatus a drip was installed upstream of run "A". Run "D" was used to measure distillate. A flash tank was installed in this system to receive distillate from the 1,000 psi separator. Pressure was slowly reduced to allow the distillate to be flashed to the test run pressure; then gas was admitted to top of the tank to force the liquid through the meter run. Rate of flow was controlled chiefly with the gas control valve.

passed through a back-pressure regulator which controlled the pressure on the entire system; it then went to the plant 600-pound gathering system.

Readings for Large Volumes of Water. During the pre-test conferences, the question arose whether any readable differential charts would be obtained when large volumes of water were mixed with the gas. For economy on the original installation, an adjustable choke was used on the inlet gas to control volume; a high-pressure wobble meter was used for the liquid and a conventional back pressure regulator was used to control the pressure.

When the first series of tests were run, it was found that meter runs B and C would stabilize and draw a straight line within 30 seconds after a change was made in the liquid rate. It was necessary to improve the control equipment, so a flow controller was installed in place of the hand control for the gas; an orifice meter was installed in place of the wobble meter for measuring liquid.

Distillate Apparatus. A small drip was installed ahead of the orifice plate in Run A to remove any liquid in the distillate set up. When tests were run at pressures only slightly below 1,000 pounds, no liquids would accumulate; however, at progressively lower pressures, hydrocarbon liquids accumulated due to retrograde condensation; this would affect the accuracy of the meter.

Flanged taps were used throughout all meter runs met the requirements of The American Gas Association Committee Report Number 3. Meters with a working pressure of 4,500 psi, were used with a 2,000-pound spring and 100-inch differential tube. The differential tube was calibrated before the start of the tests against a manometer; it was also checked several times during the tests. All differential readings were taken from the meter chart, but static readings were taken with a dead weight tester to the nearest pound.

Although 24-hour charts were used, 6-hour clocks were installed to speed up movement of the chart and amplify variation in either the static or differential pressures. Specific gravity of the gas was determined with an Acme balance. Indicating thermometers, range 0-120° F., were used on each run.

Procedure Tests. The first series of tests were run using 1.250-inch orifice plates in all three gas meters, and at a pressure slightly over 900 psi. Blank checks were run on the three gas meters by passing dry gas through the system: first runs were at approximately 10 inches of differential, then increasing to 30 inches, 80 inches, and reducing the flow back to 50 inches, 15 inches, and 10 inches of pressure differential. All meters checked within the accuracy normally accepted by industry.

To start the tests, a flow of about 10 inches differential or 1 million cubic feet of gas per day was set (standard base conditions of 60° F. and 14.65 psi absolute). Then water was injected to the system at a low rate. After equilibrium had been established on meters B and C, simultaneous readings were taken on all three gas meters.

The water rate was then increased, and another set of readings was taken. Water rate was increased in increments until a rate of about 500 barrels per million cubic feet of gas was reached, readings being taken at each water rate. Then the water rate was decreased in increments back to the initial rate, readings being taken at each injection rate.

Next gas flow was increased to slightly over 20 inches differential, or 1½ million cubic feet of gas per day, and another group of tests were run at varying water rates.

At the completion of this series of tests, pressure was reduced on the sys-

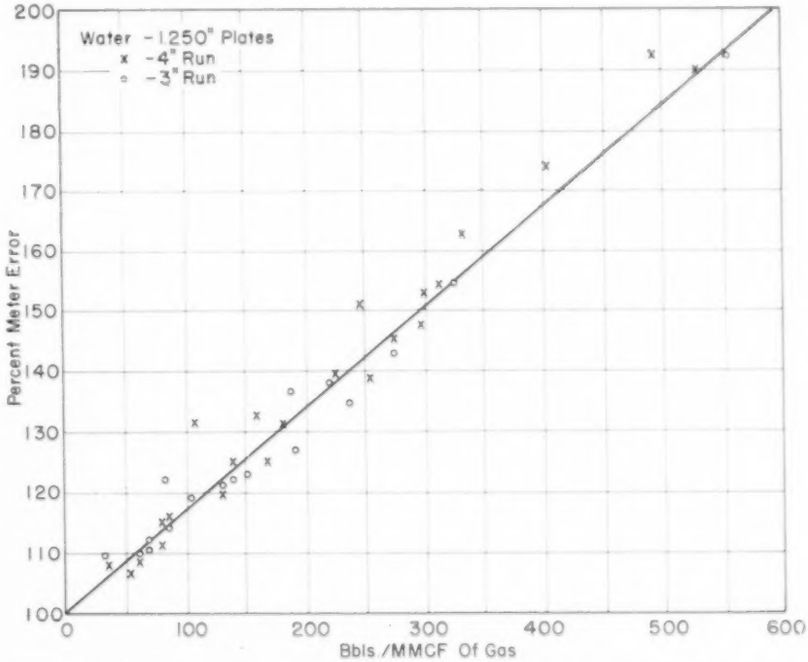

FIGURE 3—Plot of percent meter reading compares ratio of runs "B" and "C" to the dry gas volume measured on run "A" against barrels of water added per million cubic feet of gas. Results give practically a straight line function for the 3- and 4-inch tests.

tem, and complete series of tests were run at incremental lower pressures.

Calculations of Results. For the calculation of the quantity of gas, the following formula is used:

$$Q_h = C' h_w p_f$$

in which

Q_h = Quantity rate of flow at base conditions, cubic feet per hour.
C' = Orifice flow constant.
h_w = Differential pressure in inches of water.
p_f = Absolute static pressure in pounds per square inch.

The orifice flow constant, C', may be defined as the rate of flow, in cubic feet per hour, at base conditions, when the extension, $h_w p_f$ equals one. It is to be calculated by the following equation:

$$C' = F_b \times F_r \times Y \times F_{pb} \times F_{tb} \times F_{tf} \times F_g \times F_{pv}$$

in which

F_b = Basic orifice flow factor
F_r = Reynolds' number factor
Y = Expansion factor
F_{pb} = Pressure base factor
F_{tb} = Temperature base factor
F_{tf} = Flowing temperature factor
F_g = Specific gravity factor
F_{pv} = Supercompressibility factor

In calculation of the gas volumes, all of the various factors were used from the tables given in The American Gas Association Committee Report Number 3, except the Basic Orifice Factor, F_b, and the Supercompressibility Factor, F_{pv}.

Although the diameter of the orifice plates and the inside diameter of the meter runs were well within the tolerances given in Committee Report Number 3, they were not exact to .001 of an inch. Consequently, the F_b factors were calculated from the F_x and F_{tf} factors.[2]

It was believed that the F_b factors thus calculated would be more accurate than factors published in Committee Report Number 3. It might be noted that the F_b calculated factor varied from the published factor from a minimum of 5 to a maximum of 18 in the fifth significant figure.

Supercompressibility factor, F_{pv}, was obtained from tables calculated from the formula given in Bulletin No. T9-354 of the California Natural Gasoline Association.[3] These tables were used in preference to those given in Committee Report Number 3 due to the rapidity with which the F_{pv} factors could be determined. Even if in slight error, they would have no significant effect upon the final results, since the same temperature and gravity and the same pressure within five pounds were used in determining the factors.

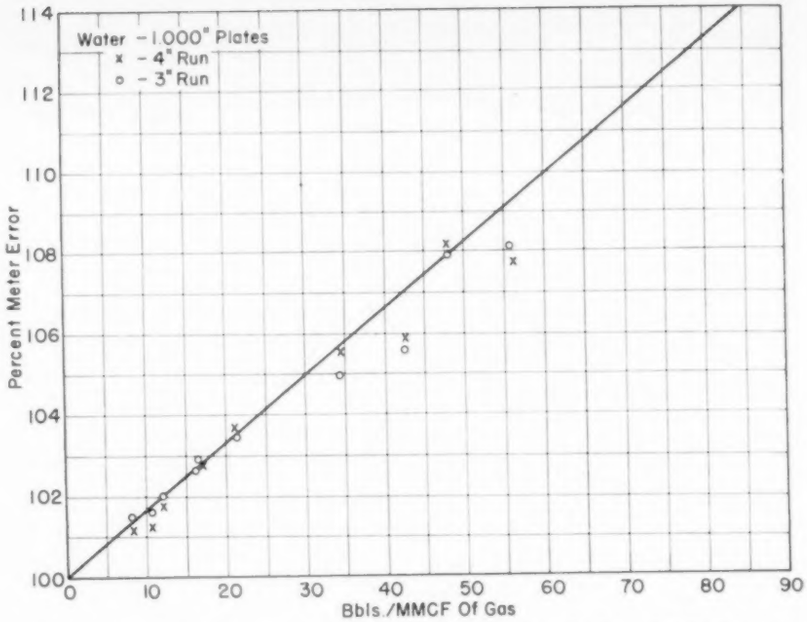

FIGURE 4—Results of water measurement through 4-inch and 3-inch meter runs using 1-inch orifice plates.

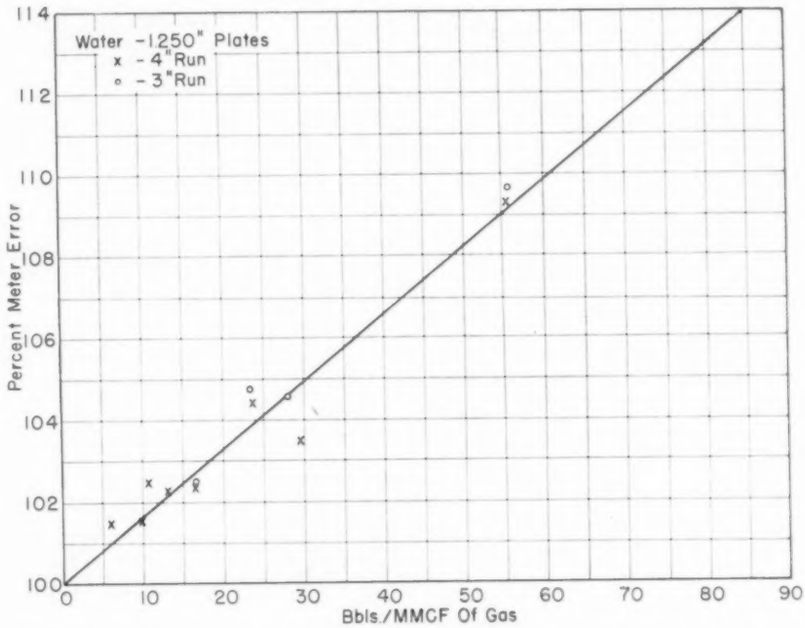

FIGURE 5—Test results with 1.250-inch orifice plates show percent meter error in 4-inch and 3-inch runs compared with barrels per million cubic feet of gas.

Although atmospheric pressure was checked on an aneroid barometer during the tests, an absolute pressure of 14.4 psi was used in calculating the extension; it would have no appreciable effect upon the results, because of the high pressures involved.

Dry Gas Gravity Used. Specific gravity of the dry gas was used in determining the Specific Gravity Factor F_{gt}, on all three meters, even on B and C. This is the most important factor of the entire investigation. It was known that adding liquid water to a gas would increase its specific gravity. However, the gravity of this two-phase stream was not known; even if it were known, no tables or formula were available with which the F_{gt} factor could be calculated.

Object of the test was to obtain a correction factor, if possible, which could be applied to a volume of gas measured by an orifice meter, based on the gravity of gas determined by conventional methods, when the volume of water present was known.

Blank check tests run on the three meters at the start of the tests, of

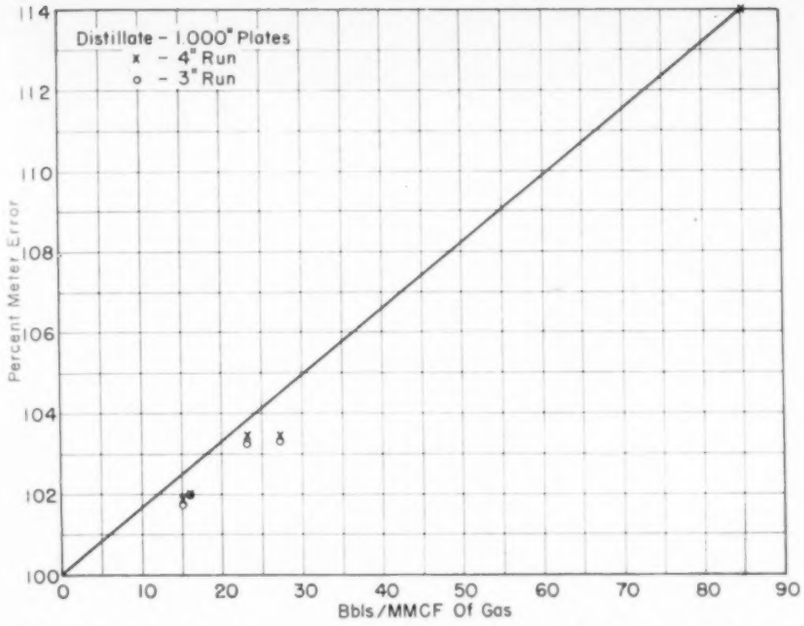

FIGURE 6—Test results comparing meter error for 4-inch and 3-inch runs having 1.00-inch orifice plates show affect of distillate concentration in gas stream.

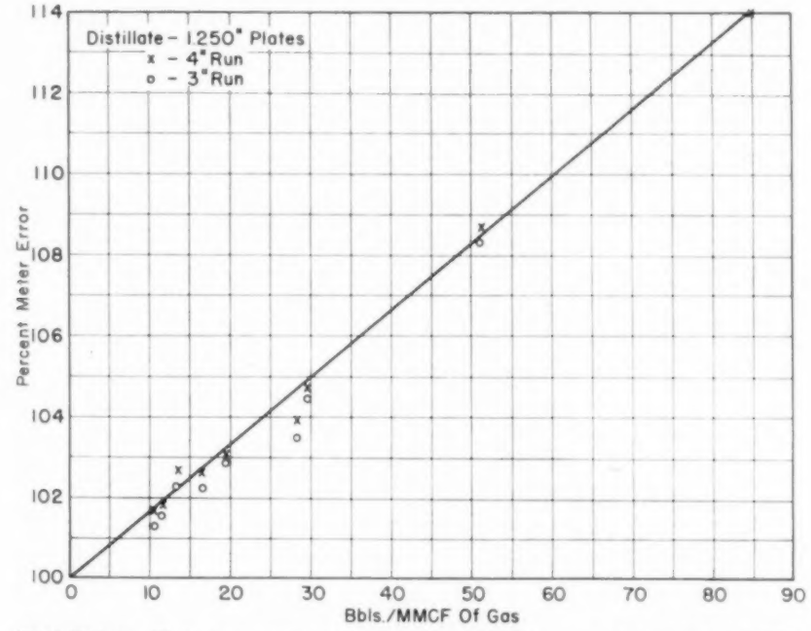

FIGURE 7—Plot of percent meter error for distillate, gas mixture using 1.250-inch plates and 4-inch and 3-inch meter runs.

course, did not agree entirely. Not knowing which meter was 100 percent correct, a mean volume was determined for each flow rate. From these mean volumes, correction curves were drawn for each meter, which were used in making very minor corrections in the calculated volumes on each test.

From the corrected dry gas volume measured and volume of water added, a liquid rate in barrels per million cubic feet of gas was calculated for each test.

Using the dry gas volume as measured on Run A as correct, the percent increase in indicated volume due to entrained liquid was calculated for Run B and C. As an example, if the dry gas volume on Run A was 919 thousand cubic feet, and Run B indicated 1,158 thousand cubic feet, then Run B indicated 1,158/919 or 126.01 percent of the true volume when 168.63 barrels of water were added to 1 million cubic feet of gas.

By plotting the percent increase against barrels of water per million cubic feet of gas curves were drawn using the acceptable data for all tests.

Effects of Liquid Water. Since the effect of liquid content upon orifice measurement was unknown, it was originally believed that a series of curves might be required for different pressures, and possibly even for different size orifice plates and meter runs. However, when all the data were assembled and plotted, it was found that all the results fell remarkably close to the same curve regardless of the static pressure, differential pressure, size plate, or size meter run. Further study of the plot reveals that the curve is practically a straight line function.

Because several points fell well off the curve it was believed that more accurate measurement could be obtained by using an orifice meter on the liquid to replace the positive displacement meter. Consequently, a 20-inch mercury type meter with a working pressure of 2,000 pounds, was installed; a second series of tests were run at considerably lower liquid rates.

Viscosity Effects. Some difficulty was encountered in determining an accurate coefficient for measuring the water due to the effect of viscosity at low flows. The F_v viscosity data published in the handbook[2] could not be used because flows were lower than the minimum data listed. It was found that data set forth in curves and tables were available in another handbook[4] which could be applied in the majority of the flow calculations.

It should also be noted that temperature-gravity data and viscosity data are not available on salt water solutions. Since salt water was used, a sample of the salt water was submitted to a commercial laboratory, and viscosity and gravity determinations were run at 60 and 100° F. From these data, curves were plotted from which the necessary factors were calculated. Solubility of the gas in the salt water would have minor effect, but it was believed to be inconsequential.

Viscosity data are also available in an orifice handbook.[5] A comparison between hand book data[4,5] reveals a variation as great as 2 percent in very low flows. Data[4] were used in the liquid calculations because they were presented in a manner which could be used more conveniently. Curves are shown on Figures 4 and 5.

Test Difficulties. During the running of the second group of tests, it was

found that a small amount of liquid had accumulated in the mercury chamber of the 3-inch meter C. Calculation of volumes showed an unacceptable variation so the entire group of *C* results were discarded; a third group of tests were run to obtain additional data on the *C* run.

At the start of the third group of tests a leak developed in the mercury tube on the liquid meter. Rather than make repairs, a bellows meter, 0-100 inch, was installed. Results of these latter tests are also shown on Figures 4 and 5.

Slope of Curves. Determination of the slope of the curves should be explained. It was believed that if check result points could be obtained at high ratios of liquid to gas, percent error would be minimized and a more accurate slope determined. Two close check points were obtained at about 550 barrels of water per million cubic feet of gas, and a straight line was drawn from this point to zero. It can be seen that this line falls on the average of the other points determined on the first group of tests. Then, a line at the same slope was drawn on all the other group two and three tests run, as shown on curves 4, 5, 6, 7, and 8.

Effects of Distillate. It was apparent at the conclusion of Group 1 tests that a straight line function was being obtained with water as a liquid. The question arose as to what effect specific gravity of the fluid in the liquid phase would have upon the measurement. So it was decided to run tests on distillate.

Since distillate was being separated at equilibrium conditions of 1000 psi and 100° F., any decrease in pressure would cause the distillate to boil, which would give trouble and cause inaccuracies in the liquid meter. To remedy this condition, a flash tank was installed in the system. Distillate was transferred from the 1000-pound separator to the flash tank, and the pressure slowly reduced to allow the distillate to be flashed to the pressure at which the test was to be run. Then gas was admitted to the top of the tank to force the liquid through the meter run, the rate of flow being controlled chiefly with the gas control valve.

Viscosities and gravities were determined by a commercial laboratory, and correction curves were drawn and applied following the method used for the salt water. Gravities were determined at atmospheric pressure whereas the distillate was measured at 600 and 900 pounds respectively. If more accurate results are desired, gravities should be determined at those pressures.

Figures 6 and 7 show the results for both the 1.000-inch and 1.250-inch orifice plates. Note that the same slope of the line was used for Figures 6 and 7 that was used for Figures 3, 4, and 5.

Figure 8 was prepared by plotting all the data obtained from group 2 and 3 tests; this includes results at pressures of 600 and 900 psi for 3-inch and 4-inch meter runs using 1.000-inch and 1.250-inch orifice plate; differential pressures varied from 10 to 80 inches of water, water and distillate rates from 6 barrels to 50 barrels per million cubic feet of gas. The slope used was based on 550 barrels of water per million cubic feet of gas; these results effected an increase in reading of 91 percent.

Reading Percent Correction. This same slope indicates that 85 barrels of liquid per million cubic feet of gas would effect an increase in reading of 14.07 percent, or one barrel would give an increase in reading of 0.1655 percent. If amount of liquid could be measured, the percent error could be determined from the curve; then the true volume of gas could be calculated by dividing the recorded volume by this factor. To simplify use of the

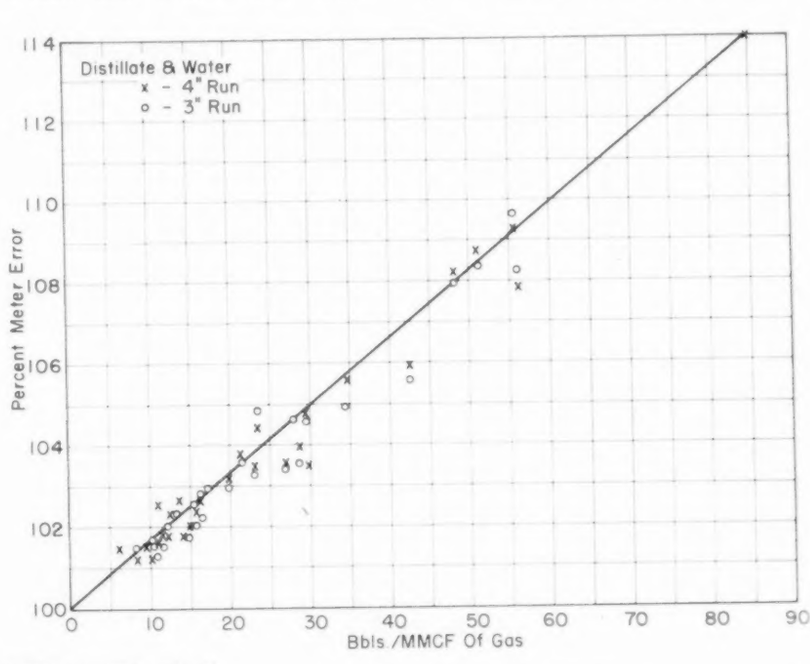

FIGURE 8—Plot of all test results showing both water and distillate runs in 4-inch and 3-inch meter runs. A reasonably good straight line was obtained.

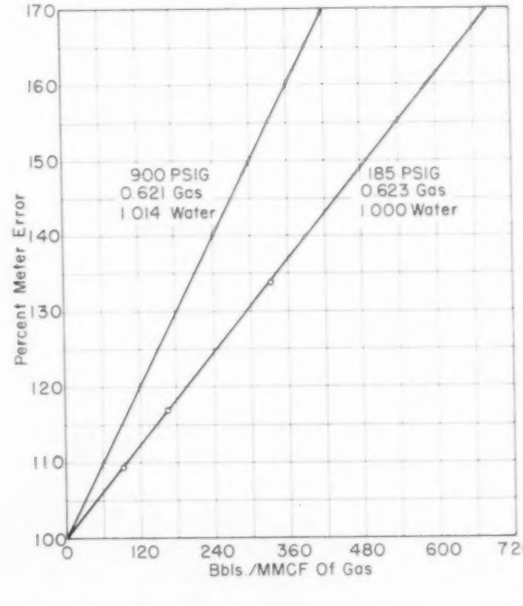

FIGURE 9—Plot of percent meter error using meter runs "A" and "B" only at test pressure of 185 psi. The percent meter error for a given liquid-gas ratio were much less than in the 600 to 900 pound range of pressure test. This variation became very noticeable at very low pressures (near atmospheric) and at high liquid rates such as 800 barrels per million cubic feet of gas.

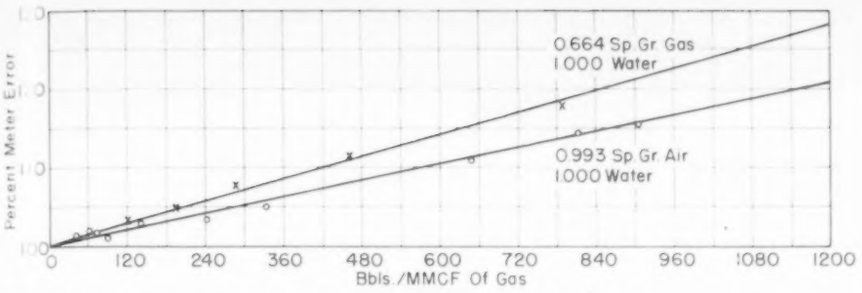

FIGURE 10—Test results plotted for runs using a 1-inch by 4-inch meter run, and a water manometer to measure pressure differential instead of the conventional mercury differential meter. Affects of water upon both gas and air are shown. Percent meter error was less for the higher gravity air than for the .620 gravity gas.

curves, the percent correction could be plotted as the reciprocal, and the true gas volume calculated by multiplying the recorded volume by the factor.

From the data collected, it would appear that the effect of liquid commingled with gas passing through an orifice plate is not dependent upon the gravity or characteristics of the liquid. It would seem that the increase in differential pressure is a function of the actual volume of the liquid passing through the plate, irrespective of the specific gravity or weight of the liquid.

When orifice plates were changed, a water mark was noted which was different from that anticipated. The level of the water ahead of the plate was lower than that expected and apparently the liquid coned up appreciably in passing through the orifice.

What Test Results Mean. Many of the points do not fall exactly on the correction curve. However, in many cases the increase in differential pressure due to entrained liquid was very small; this resulted in calculated increases in volume of only 1½ percent. Such readings were obtained even though the accuracy of the orifice meter itself is limited to about ½ percent. All differential pressures were estimated to the nearest $\frac{1}{10}$ inch.

Due to the large number of readings taken under various conditions with 10 barrels to 500 barrels of liquid per million cubic feet of gas, use of a correction factor taken from this survey should provide measurement more accurate than the gas volumes calculated with the standard gas measuring equipment in current use. Application of this test data is only as accurate as the determination of the liquid content. Additional tests and research could be run under similar conditions, using greater variations of liquid of different specific gravity.

Accuracy of measuring dry gas is being constantly improved, and it is believed that the state regulatory bodies, producers, and plant processing companies would be equally interested in improving the accuracy of wet gas measurement. Test data submitted here are presented to industry for consideration; further action may be taken after their recommendations are received.

Additional Tests. Following the original tests another series were run at a pressure of 185 psi using *A* and *B* runs only. The meter was removed from the *C* run and installed on the *B* run using pipe taps to obtain a comparison between flange and pipe taps. Results indicated no difference between flange taps and pipe taps at several different liquid to gas rates.

However, it was found that the percent error due to the liquid, was less at the 185-pound pressure than in the 600- to 900-pound range. This variation became very noticeable at very low pressures near atmospheric, and at high liquid rates such as 800 barrels per million. At the conditions of the original test, i.e., 600 to 900 psi and liquid rates up to 50 barrels per million, variation was so small as to be within the range of accuracy of the meter.

Water Manometer Tests. For another test, a standard 1.000 inch by 4.000 inch meter run was used. However, a water manometer was used to measure the differential instead of the conventional mercury differential meter. Effects of water upon both gas and air, were tested, running the tests at atmospheric pressure. As can be seen from Figure 10, the percent meter error was less for air than for the 0.620 gravity gas.

Physical Observations. Another run was made at atmospheric pressure, using a bright light shining through the downstream meter tube, to the orifice plate. The physical variation in the flow could be observed at changing differential rates. At low gas flows below 10 inches differential and low liquid rates, liquid actually flows over the plate in a small stream. At very low liquid rates, about one barrel per million, a negative increase was shown; the differential actually decreased $\frac{1}{10}$ inch of water.

When the differential was increased to 10 inches, flow suddenly became very turbulent. This action may account for the liquid which was found in the gage lines, particularly the downstream tap on the 3-inch meter run, during the original tests. At flows above 10 inches, the liquid passed through the plate as a mist.

These latter data are so recent that no verification of the calculations nor conclusions have been made at this time.

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1. American Gas Association, Committee Report No. 3.
2. American Meter Company, Handbook E-2, 1955.
3. California Natural Gasoline Association, Bulletin No. TS-354.
4. THE ORIFICE METER, published by Rockwell Manufacturing Company, 1953.
5. FOXBORO HANDBOOK, published by The Foxboro Company.

ACKNOWLEDGMENT

From a paper presented at the 13th Annual Short Course in Gas Technology, Texas College of Arts and Industries, Kingsville, Texas.

About the Author

Roy A. Schuster has over 30 years experience in the natural gas industry. On graduation from Case Institute of Technology with a B.S. degree in chemical engineering in 1929, he became associated with the subsidiary companies of the Columbia Gas and Electric Corporation in the natural gasoline division. In 1945 he joined the Chicago Corporation as manager of plants. This long experience with the gas industry from research to operations led to the vocation of a professor; he joined the staff of the Division of Engineering at Texas College of Arts and Industries in 1957. In the Department of Petroleum and Natural Gas Engineering Schuster devotes research and teaching efforts to the fields of materials of engineering and the production and measurement of natural gas.

Spotlight on Hiring Hall Practices

To meet Taft Hartley requirements, contractors must . . .

- **Make sure that hiring is on a non-discriminatory basis with respect to union membership**
- **Retain right to reject any job applicant**
- **Post notice of hiring arrangement—including safeguards**

Digest of an address by Jerome D. Fenton, General Counsel National Labor Relations Board

As YOU KNOW, the hiring hall has frequently been an integral part of the closed-shop system. In some industries, the building and construction industry among them, an employe was traditionally required to be a union member in good standing in order to obtain a job referral from a union hiring hall.

The hiring hall evolved because of the unique problems existing in industries like the construction industry. Often a contractor finds himself a stranger in a particular area: before he can bid on a job he must estimate the availability and the cost of his labor force. He must be able to recruit quickly a group of workmen who are proficient in a variety of crafts, and usually he will not have any personal knowledge of the qualifications of individual job applicants. For these reasons, the contractor finds it necessary to utilize some central source for employment information and for recruiting workmen.

Problems of the craftsmen who serve the construction industry are also perplexing. Work opportunities are often sporadic and at great distances from one another. Employes rarely work for a single employer for any great length of time, and hence do not accrue plant or employer seniority in the usual sense. The solution to the joint problems of management and labor in these respects was found in the development of union hiring halls and referral systems. Contractors were assured a source for the skilled labor they needed; and at the same time employes were made aware of job opportunities. As a result, a relatively fair method evolved of allocating available jobs to the workmen.

Taft-Hartley Prohibitions. When the Taft-Hartley amendments were passed, the closed shop, permissible under the Wagner Act, was declared unlawful. Congress, in enacting the amendments, was particularly concerned with the close-shop nature of hiring halls in industries such as yours.

Cases that came to the National Labor Relations Board in the years following the Taft-Hartley amendments did nothing to allay this Congressional concern. In case after case, the evidence showed, and the Board found, that hiring halls and referral systems, despite the prohibition of Section 8(a)(3) and 8(b)(2) of the Act, were still operated so as to prefer union members.

The Mountain Pacific Case. These were the practical considerations facing the Board when it decided to take a new look at hiring halls. As the *Mountain Pacific* decision shows, these were the factors that influenced the Board to decide the case as it did.

In *Mountain Pacific*, a contract between the union and the employer provided that recruitment of employes should be solely the responsibility of the union. The Board, in resolving

the question of "whether the written contract, apart from all other evidence in the case, is itself unlawful because of the exclusive hiring hall it contains," deemed it significant that the contract was "silent as to methods or criteria to be followed by the union in performing its function as hiring agent."

This gave the union complete and uncontrolled discretion over the hiring function. For in the words of the Board: "Faced with this hiring hall contract, applicants for employment may not ask themselves what skills, experience or virtues are likely to win them jobs at the hands of contracting companies. Instead their concern is, and must be: what, about themselves will probably please the unions or their agents; how can they conduct themselves best to conform with such rules and policies as unions are likely to enforce; in short, how to ingratiate themselves with the union, regardless of what the employer's desires or needs might be."

It was for these reasons that the hiring hall agreement in *Mountain Pacific* was found by the Board to violate the Act. "The employers," the Board concluded, "have surrendered all hiring authority to the Union and have given advance notice via the established hiring hall to the world at large that the Union is arbitrary master and is contractually guaranteed to remain so. From the final authority over hiring vested in the respondent union . . . the inference of encouragement of union membership is inescapable." This complete surrender of all hiring authority by the employer to the union, and the lack of any standards, or criteria by which referrals were to be made by the union, proved fatal to the contract in *Mountain Pacific*.

Not All Exclusive Hiring Halls Killed. At the same time, however, the Board pointed out that it was not requiring the elimination of all exclusive hiring halls. To negate "the inherent and unlawful encouragement of union membership that stems from unfettered union control over the hiring process," the Board listed certain minimum requirements which must be incorporated into any exclusive hiring hall agreement as safeguards:

1. Selection of employes shall be on a non-discriminatory basis and shall not be based upon, or in any way affected by, union membership, by-laws, rules, regulations, constitutional provisions, or any other aspect or obligation of union membership, policies or requirements.
2. The employer retains the right to reject any job applicant referred by the union.
3. The parties to the agreement post in places where notices to employes and applicants for employment are customarily posted, all provisions relating to the functioning of the hiring arrangement, including the safeguards that we deem essential to the legality of an exclusive hiring agreement.

Clarification of the Law. This definitive treatment of the hiring hall question by the Board, although very significant, is not a wholly new policy, but represents, in large measure, a clarification of the law in this area. In fact, in the very first case after the passage of the Taft-Hartley amendments that dealt directly with the validity of a hiring hall contract,[2] the Board found lawful a contract which provided that the hiring hall was to be administered without discrimination, and that the employer had the right to reject any employe referred by the union.

If you compare these two contractual provisions with the safeguards listed by the Board in *Mountain Pacific*, you will see that they constitute two of the three safeguards essential to the legality of exclusive hiring halls. So the recent decision is basically an evolution of that earlier case. The additional requirement now imposed by the Board is that all provisions relating to the hiring procedure be posted by the parties so that all employes and applicants for employment are fully apprised of them, the third safeguard enumerated by the Board in *Mountain Pacific*.

I do not want to leave you with the impression that I think this third safeguard is not significant. My view, in fact, is that it is perhaps the most important of the three. For putting employes on notice of the non-discriminatory criteria, or standards upon which the union bases its referrals is, I believe, the means of giving substantive assurance to them of the guarantees against discrimination.

But it is not enough that the union and employer merely disavow an intent to discriminate and to avoid actual discrimination. The need for the hiring hall safeguards spring not only from the Taft-Hartley provisions which ban discrimination, but arise equally from the ban against restraint or coercion of employes contained in other provisions of the Act, namely, Section 8(a)(1) and Section 8(b)(1)(A). Violations of both these latter sections were found by the Board in *Mountain Pacific*, and in the other hiring hall cases.

Elimination of possible restraint or coercion of jobseekers is as much at the heart of the matter as the elimination of possible discrimination. But, in reply, it may be asked: Doesn't the posting of notices that make clear that there will be no discrimination in hiring take care of any possible restraint or coercion? I think not.

Even if such notices are coupled with a declaration against discrimination in the contract, I do not believe that it necessarily fulfills the *Mountain Pacific* requirements. Employes, I believe, may also be restrained and coerced by a contract which vests unilateral control in the union over any hiring procedure, because it creates a *fear* that there will be discrimination notwithstanding general reassurances to the contrary.

Excessive Delegation of Hiring Control to Union. Two Board decisions are illuminating on this point. One is *Pacific Intermountain Express*[3] decided before *Mountain Pacific*, and the other is *Houston Maritime*[4] decided since. In both *Pacific Intermountain* and *Houston*, the evil found was excessive delegation to the union of control over the hiring process. No question of failure to post was raised in either case, but it seems clear that no type of posting could cure the evil. Moreover, the contracts in both cases specified that there should be no discrimination against non-members. Nonetheless, the Board found that the contract provisions *per se* violated all pertinent sections of the Act. The only essential difference between *PIE* and *Houston* was that in the former case the union was delegated control over seniority; in the latter case the union was given control of the selection of the gang foremen who did the hiring.

These cases appear to be equally applicable to contract provisions which propose to turn over to the union the task of drafting the rules for operation of the hiring hall. Drafting the rules must of necessity include the power to fix the standards for hiring and consequently the order of

hire. Further, if the union is left free to draft the rules, it also presumably could change them. For example, the power to shift at will and without notice, from a geographic bases of hiring to straight seniority or to "longest unemployed"—seems to come within the "unfettered control" of the hiring process which the Board condemned in *Mountain Pacific* and in *Houston*.

Thus, I am impelled to conclude that the standards for hiring must be fixed by the collective bargaining contract, i.e., by mutual agreement and must not be open to unilateral change by the union. Otherwise, the jobseeking employe must look solely to the union for his chance of obtaining a job which I regard as precisely the type of restraint or coercion which was struck down in *PIE* and *Houston* cases.

Labor, Industry Cooperation Essential. Effectiveness of the *Mountain Pacific* approach to the exclusive hiring hall problem will depend in large measure upon the degree of cooperation between leaders of industry, labor and representatives of government. It has been aptly said that "The man who does no wrong needs no law." Unfortunately, experience has shown that wrongs do occur, and it is then that the government is forced to step into the picture.

Generally, without doubt there is a very high degree of acceptance by both unions and employers of the specific provisions, and indeed, the basic purposes of the Act. In the less than ten months since the Board issued *Mountain Pacific*, the earnest efforts of both employers and unions in the construction industry to adjust to that decision have already been clearly manifested. International unions have, I know, been preparing and distributing to their constituent locals explanations of the *Mountain Pacific* decision, and suggestions for adapting their hiring arrangements to it. Trade associations have done the same for their employer members. Contracts have been revised, and are being studied with an eye toward meeting the standards now required. Needless to say, I am extremely gratified by this response and evident spirit of cooperation.

Court Review Likely. The last word on the complex problem of hiring halls and referral systems has not yet been spoken. The *Mountain Pacific* decision and its ramifications are still to be considered by the courts. Indeed, it is not unlikely, in view of the significance of the problem, that the Supreme Court will be called upon to determine the issues finally.

Meanwhile, I cannot attempt to answer even a sampling of the multitude of questions my office receives almost daily regarding the scope of the hiring hall decision. There are as yet no certain answers to most of these questions. However, both the Board and the courts will add to the development of the law in this field as time goes on, and gradually answers will emerge.

The Brown-Olds Remedy. I want to touch briefly on another principle that has great impact on employers and unions in the construction field. That is the so-called Brown-Olds remedy.[5] Basically this remedy requires that employers[6] and unions who, because of the existence of illegal union-security agreements, have coerced employes into becoming members of the union, must refund the full amount of dues and assessments collected from the employes for as far back as six months prior to the filing of the charge.

In one case, *Los Angeles-Seattle Motor Express, Incorporated*,[7] the Board also applied the *Brown-Olds* remedy, requiring both the employer and union charged, jointly and severally, to reimburse all dues and fees paid by employes where the provisions of an exclusive hiring agreement were unlawful as failing to contain the *Mountain Pacific* safeguards. This remedy applied to all employes of the respondent Company who were subject to the provisions of the exclusive hiring agreement. As the Board reasoned:

> By the illegal hiring provisions of their contract, [the employer and the union] have unlawfully encouraged employes to join the Respondent Union in order to obtain . . . employment, thereby inevitably coercing those employes to pay union initiation fees and dues. It would not effectuate the policies of the Act to permit the retention of the payments of these union initiation fees and dues which have been unlawfully exacted . . . .

In short, just as each case is decided upon the particular facts involved, so the remedy fashioned by the Board depends upon the nature and breadth of the violation found. Therefore, when in the Board's judgment, the facts in a particular case makes the *Brown-Olds* remedy necessary in order to correct the effects of an illegal union-security clause or of an illegal hiring arrangement, the Board's order includes that remedy.

Voluntary Actions During Grace Period. It has been the policy of the Office of the General Counsel to extend to parties a grace period within which to conform their agreements and practices to the letter and spirit of the Act. My hopes have been that the parties would thus, of their own volition, correct their illegal hiring arrangements and achieve the basic purpose sought by the Board without the necessity of formal Board action. Voluntary action to bring hiring arrangements within the framework of the *Mountain Pacific* decision has been the rule rather than the exception. The moratorium period which extended throughout most of last year, has proven to be, on the whole, a demonstrated success.

Moratorium Now Over. Now that the moratorium is over, all cases will be handled in accordance with the Board's regular policies. Where the facts and circumstances of the particular case warrant settlement without the imposition of the *Brown-Olds* remedy—or, for that matter, any other remedial measures—such settlement may be available. On the other hand, where the facts and the circumstances indicate the need for a more stringent remedy in order to achieve the purposes of the Act, the Board will require and obtain the full *Brown-Olds* remedy. It has always been the policy of the Office of the General Counsel to give every reasonable assistance to employers and unions in resolving their particular problems. I hope that these remarks have furthered this policy. They were intended to offer light and dispel darkness on a difficult and challenging subject.

REFERENCES

[1] Mountain Pacific Chapter of the Associated General Contractors, Inc., 119 NLRB No. 126-A.
[2] National Union of Marine Cooks and Stewards, 90 NLRB 1099.
[3] 107 NLRB 837, enforced 225 F. 2d 343 (C.A.3).
[4] 121 NLRB No. 57.
[5] United Association of Journeymen & Apprentices of Plumbing and Pipefitting Industry of the United States and Canada, Local 231, AFL-CIO (Brown-Olds Company), 115 NLRB 594.
[6] Broderick Wood Products, 118 NLRB 38, enforced, 43 LRRM 2123.
[7] 121 NLRB No. 205.

ACKNOWLEDGMENT

Digested from an address given at the 11th Annual Convention of the Pipe Line Contractors Association, Bal Harbour, Florida, Jan. 13, 1959.

IDEAS FOR THE FUTURE

. . . in pipe line engineering, construction and operations

By Pipeline Pete

TIME WAS when most people didn't believe it would ever be possible to take a trip to the moon, and they *knew* there wasn't a thing anyone could ever do about the weather.

Now a moon trip is just around the corner, and every month or so, scientists are talking about controlling the weather! And chances are that if you tried to place a bet on the side of weather control in 10 years, you couldn't find a taker.

Few scoffers are found today; no one doubts the abilities of research and development. Most of us average Joes never quite got the hang of just how a radio set worked, when the "eggheads" bombarded us with TV, radar, space travel and nuclear energy. And now they are talking about controlling the weather, creating a new chain of living things and taking trips to Mars etc.

The only thing we can do is accept the bountiful blessings of the laboratories, and hope someone will devise a means of getting nations on this earth to play square with one another before the whole thing blows up.

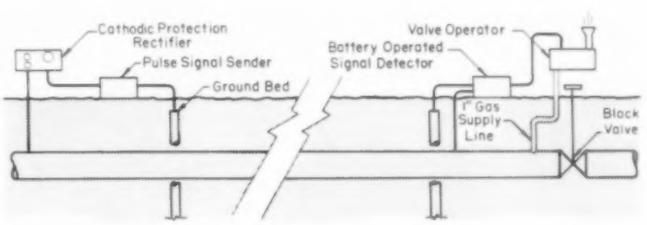
Because developments are coming so thick and fast, this series has been started to summarize quickly some of these "astounding science" ideas that might be applicable to the pipe line industry. In addition, we will print items that have no other quality than their novelty—just to make the series more interesting.

Communications by Pulsed Cathodic Protection

The production department of one of the large oil companies has been experimenting with this method for remote operations in the Gulf of Mexico. Although the company has not yet concluded this work and has yet to make an official announcement, reports indicate that engineers have been successful in opening and closing valves on distant platforms by simply pulsing the current which is impressed on the underwater lines for their protection.

This certainly seems feasible. Salt water is an excellent conductor of electrical current as is steel pipe. There is little doubt that a signal such as a series of pulses in the voltage of the normally stable cathodic protection current could be detected at some distance. Moreover, there are any number of instruments that can interpret and act upon these signals.

Would such a system as this work on dry land? Perhaps. We are certainly able under most circumstances to maintain an impressed voltage on a pipe line with rectifiers and ground beds. Also, we are able to measure this current at distant points with copper sulphate cells etc. Perhaps it might be possible to signal, "*tum-ti-dum-dum*" at the rectifier and cause a block valve down the line to open or close. Of course, such a system would be somewhat limited. No voice channels; and unless additional equipment was installed at the receiving end, there would be no replies.



Water in Crude Lines May Be a Help!

A number of Canadian scientists think that injecting water into oil pipe lines may lead to a substantial savings in pumping costs. A film of water next to the wall of the pipe can reduce pressure drop per lineal foot as much as 1/500th according to theoretical studies.

These are part of the findings of the Research Council of Alberta, engaged in research on pumping heavy crudes. Explanation is that the presence of water in the area of maximum frictional losses—at the pipe wall—greatly reduces the energy loss at the walls.

A number of U.S. pipeliners have pointed out the possibility of advantages of water-wet pipe in handling products. When water is in possession of the surface of the pipe wall, there may be less co-mingling of products.

Water takes possession of the surface during hydrostatic tests and resists displacement by hydrocarbons. As a result the smearing action of a product tender may be reduced.

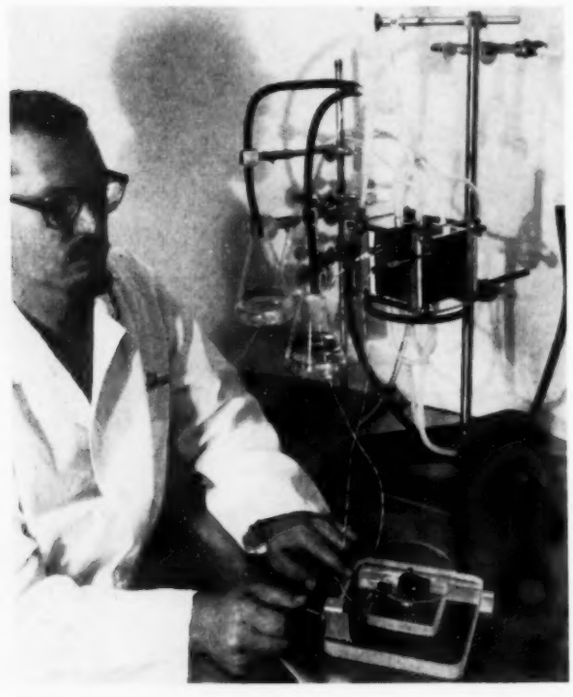
Evidence substantuating this theory was supplied by the conversion of a line that had handled only dehydrated products to butane service. It took many more runs to obtain high quality products than a similar line which had handled products containing small amounts of water. Apparently the butane was rooting out hydrocarbons that had been smeared on the pipe wall of the "dry" line. Where water is in possession of the pipe surface, there seems to be a resistance to this displacement.

Fuel Cells Could Mean Electricity From Gas

This is a possibility, and at least one research group is working on the problem. Meanwhile, National Carbon Company has announced development of a cell that produces electricity at a highly efficient rate from hydrogen and oxygen.

Such cells have been operating eight hours daily, five days a week for over a year in the company's research laboratories without showing signs of deterioration. The U.S. Army has been using some of the units to power radar sets for some time.

The cell has an efficiency of 65 to 80 percent, and its life expectancy is for all practical purposes, unlimited. It will continue to produce electricity so long as oxygen and hydrogen are fed into it.



Lockheed's New Fuel Cell

The cell has no moving parts. Essentially, it is a plastic container with two hollow, porous carbon electrodes extending through it. Inside the container there is a solution of potassium hydroxide and water. The current is produced by oxidation of hydrogen to water.

The hydrogen is diffused through the negative electrode, is ionized by electrochemical reaction with the electrolyte solution of potassium hydroxide and liberates electrons which flow through an external circuit and back to the positive electrode where electrons are accepted by the ionizing oxygen. Ionic conductivity through the electrolyte completes the electrical circuit. Water produced by the reaction usually evaporates.

Basically, the fuel cell is best suited to high-current low-voltage applications. The amount of current that can be produced is simply a function of the number of cells used to produce it.

Air can be substituted for oxygen and hydrogen of ordinary commercial purity will operate the cell. One possible source of hydrogen is water vapor and carbon monoxide present in stack gas. These two could be reacted catalytically at the electrode surface to yield hydrogen. Another source will possibly come from the reforming of natural gas.

Lockheed's Fuel Cell. Dr. Morris Eisenberg, head of Lockheed Missile Systems division's research laboratory, has announced that his company has had early success with a fuel cell and is presently attempting to develop one which will produce 100 watt-hours per pound of weight. He says that such a cell could be used to power automobiles, airplanes, etc. This cell, too, is based on an electrochemical, although it is understood that Lockheed's basic feeds are liquids rather than gas. It has an efficiency of 70 percent.

Rice Oil Stops Rust in Gulf Coast Plants

Two Gulf Coast chemical plants have been protecting yard piping from severe attack by salt air and air-borne chemicals by coating the piping with a compound made from rice oil and several other ingredients. Another company recently coated 1,300 tanks with the product as a result of tests its engineers had conducted over the past several years.

A number of companies have worked on producing an anti-rust material from rice oil—or more correctly, from rice bran oil—when it was discovered that it had anti-oxidant properties. In addition, it has penetrating qualities which carry it into the pores of steel plate. For this reason, the products resist undercreep. An ocean going barge coated with the material has completed a year's run with no evidence of rust and corrosion appearing where it was coated with this particular rice oil product.

Sounds like this may be an excellent coating for in-storage pipe.

If you have interesting unusual facts about pipe line construction or operations ideas pointing the way for future designs please send them to Pipeline Pete, PIPE LINE INDUSTRY, Post Office Box 2608, Houston 1, Texas.

Saving Money With Mechanical Anchors

This simple means of preventing gas lines from floating can save money where it is applicable. Here is the way to calculate the spacing, cost and effectiveness of the anchors

By William Hollander, Engineer
A. B. Chance Company
Centralia, Mo.

Anchoring a large diameter gas line with mechanical screw-type anchors. The well points at left have dried the sub-surface soil sufficiently to let the line rest at its proper grade. Pairs of anchors—with a holding power of 20,000 pounds per set are spaced along the line. Workmen are threading the two anchor rods through the bracket that goes over the pipe.

Screwing the anchors to depth with power equipment. Note that the bracket which holds down the pipe has rock shield beneath it to insulate the anchors from the pipe line.

MANY OF THE 25,000 plus miles of pipe line scheduled for construction this year must be protected against flotation. The additional cost of construction represented by this protection varies greatly, depending on the hold-down used. Low cost, screw type earth anchors, especially adapted for pipe line application are now being used by many major pipe line companies.

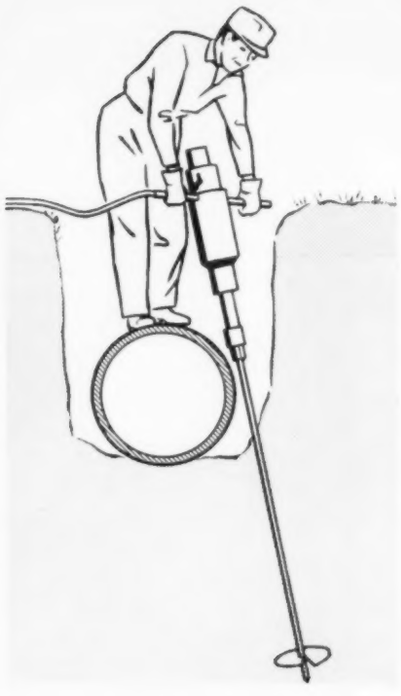
Anchoring by this means is achieved by screwing an anchor into firm subsoil on each side of the pipe and attaching them to the pipe by means of a pre-formed saddle bracket. A pad of rock shield or other non-corrosive material is used under the bracket to protect the coating and insulate the anchors from static current in the line.

The anchors screwed into undisturbed soil below the trench, without extra excavation, preserve its maximum holding capacity. Standard lengths used place the anchor blade 9 to 10 feet below grade level in the average trench. At this depth in inorganic soil, the shear strength of the soil, constituting the holding capacity of the anchor, will remain consistent through variations in the moisture condition at the surface. When necessary, longer anchors and screw-on extensions may be used to imbed the anchor in consolidated subsoil.

Holding Power of Anchors. Normally, three sizes of anchors are used—with variations in the length of the anchor rods. Table 1 gives the holding power of two mechanical screw anchors applied on either side of the pipe and linked to the pipe with a standard hold-down bracket.

The classification of soils shown in Table 1 are as follows:

- **Class 4 Soil** . . . Hard, well drained, Clay predominating.



Close-up (left) of the anchors and holding bands in position ready for installation with power tools. A special nut is used on the power tool. Drawing at right illustrates how anchors are screwed to depth.

- **Class 5 Soil** . . . Firm, moist, well drained. Clay content is high.
- **Class 6 Soil** . . . Plastic, wet, poorly drained. Clay content is fair.
- **Class 7 Soil** . . . Loose, dry, high in sand or gravel content; or loose, wet loam or gravel.

Spacing of mechanical anchors along a line subject to flotation will vary with the holding capacity of the soil, the specific gravity or weight of the mud that will act on the pipe and the stresses which will result when the positive buoyancy of the pipe is counteracted by the holding power of the anchors. The deflection of the pipe is usually calculated on the basis of a mud weight of 90 pounds per cubic foot.

In specifying the anchors and spacing of the anchors in Table 2, the various limiting factors in good pipe line construction practice are taken into consideration. In determining the spacing on pipe sizes 24 inches and smaller, the anchor size normally used

TABLE 1

ANCHOR SIZE	Anchor Area Sq. In.	Rod Size	Length	Nominal Soil-Anchor Holding Capacity in Pounds For Pair of Anchors at Each Bracket			
				Class 4 Soil	Class 5 Soil	Class 6 Soil	Class 7 Soil
6-inch	28	¾-in.	74 inches	15,000	12,000	9,000	5,000
8-inch	50	1-in.	73 inches	20,000	15,000	12,000	7,000
10-inch	78	1¼-in.	70 inches	25,000	20,000	15,000	8,000
10-inch	78	1¼-in.	100 inches	30,000	25,000	18,000	10,000

TABLE 2—Reference Table for Determining Pipeline Anchoring Requirements

Pipe Size O.D. Inches	Pipe Wall Thickness	Weight Per Ft. of Pipe & ¼" Coating in Lbs.	Displacement Lbs. Per Lineal Ft. in 90 Lbs. Per Cu. Ft. Mud	Net Buoyancy Lb./Ft.	Anchor Spacing in Feet	Anchor Load Lbs.	Resulting Bending Stress PSI S_b	Recommended Anchor Size
6.625	.280	22	25	3	82	250	2400	6"
8.625	.365	33	40	7	86	600	2800	6"
8.625	.250	27	40	13	68	430	4500	6"
10.75	.500	61	62	1	177	177	795	6"
10.75	.375	46	62	16	84	1345	3450	6"
10.75	.250	34	62	28	66	1850	5800	6"
12.75	.500	72	86	14	105	1470	2760	6"
12.75	.375	55	86	31	81	2510	4640	6"
12.75	.250	40	86	46	67	3080	6875	6"
16.00	.500	91	134	43	97	4170	4430	6"
16.00	.375	71	134	63	81	5100	5700	6"
16.00	.250	50	134	84	68	5720	8100	6"
18.00	.500	103	167	64	94	6020	4820	6"
18.00	.375	80	167	87	81	7050	6420	6"
18.00	.3125	69	167	98	76	7450	7430	6"
18.00	.250	54	167	113	70	7910	8925	6"
20.00	.500	115	206	91	93	8460	5450	6"
20.00	.375	89	206	117	82	9600	7100	6"
20.00	.3125	77	206	129	77	9950	8220	6"
20.00	.281	71	206	135	74	10000	8900	6"
20.00	.250	63	206	146	71	10350	9680	6"
24.00	.500	138	294	156	94	14680	6470	8"
24.00	.375	107	294	187	84	15700	8280	10"
24.00	.3125	92	294	202	79	15950	9360	10"
24.00	.281	85	294	209	75	15700	9940	10"
24.00	.250	77	294	217	73	15850	10500	10"
26.00	.500	149	345	196	94	18430	7000	10"
26.00	.375	116	345	229	85	19450	8600	10"
26.00	.3125	99	345	246	80	19680	9400	10"
26.00	.281	92	345	253	79	20000	10500	10"
26.00	.250	83	345	262	76	20000	11860	10"
30.00	.500	173	456	283	71	20000	4250	10"
30.00	.375	134	456	322	62	20000	4870	10"
30.00	.3125	114	456	342	59	20000	5150	10"
34.00	.500	198	584	384	52	20000	2410	10"
34.00	.375	154	584	428	47	20000	2865	10"
36.00	.625	253	654	401	50	20000	1670	10"
36.00	.500	210	654	444	45	20000	1840	10"
36.00	.375	162	654	492	41	20000	2320	10"
36.00	.3125	139	654	515	39	20000	2390	10"

TABLE 3

	24" O. D. x .250 Wall Pipe	30" O. D. x .375 Wall Pipe
Displacement per lineal foot of line	3.27 cu. ft.	5.07 cu. ft.
Weight of displaced backfill per lineal foot of line (90 lbs. per cu. ft. mud)	294 lbs.	456 lbs.
Weight of pipe including dope and wrap per lineal foot	77 lbs.	134 lbs.
Net potential buoyancy per lineal foot	217 lbs.	322 lbs.
Spacing of 10-inch anchor sets (with 70-inch rods and standard 4-inch saddle bracket). Nominal holding capacity per set 20,000 lbs. (class No. 5 soil) with 2 to 1 factor of safety. 20,000 lbs. ÷ potential buoyancy x ½	46 ft.	31 ft.
Price per set of 2 anchors and bracket, plus estimated freight	$25.15	$26.10
Installed cost per set including $20 per set standard contractors installation price	$45.15	$46.10
Installed cost per mile of line	(115 sets) $5,192.25	(171 sets) $7,883.10

will provide more holding capacity than required to restrict the potential force of buoyancy. Thus ample safety factor is automatically included for low strength soils.

The maximum spacing recommended is governed by the most critical limiting factor, i.e., the potential deflection in the span if subject to the maximum buoyancy when submerged in a 90 pounds per cubic foot backfill mud. The spacing shown restricts the potential deflection due to force of buoyancy to ¾ inch in the span.

Where diameters are 26 inches or over, the rigidity of the pipe is sufficient to safely withstand the buoyancy force with spacing of the anchors at their safe holding capacity. Although larger anchors might be considered in order to use a longer spacing on the larger diameter and heavy wall pipe, the size anchors recommended in the table are limited to sizes and lengths that can be efficiently installed with light weight power units.

Costs. The cost figures used here are actual ones taken from recent construction projects. Of course, these costs will vary with individual projects.

One of the important advantages of mechanical anchors is the low cost of transporting them to the job site. For instance the total weight of 115 sets of 10-inch anchors and brackets necessary to hold down a mile of 24-inch x .250 wall pipe is only 9,702 pounds.

Table 3 shows two typical examples of cost calculations: What would it cost to anchor a mile of 24-inch x .250 wall pipe and a mile of 30-inch x .375 wall pipe if both of them were coated with ¼-inch of pipe line enamel and wrap?

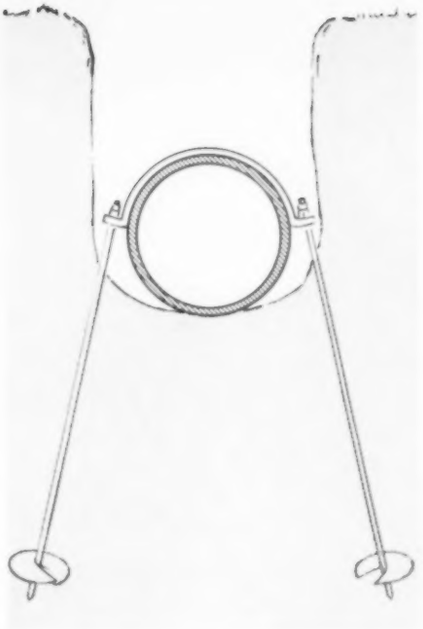
Field Installation. Installation of the anchors may be done by hand when only a few sets are involved. However, mechanical power installation is more practical. The top end of the anchor rods being threaded, a patented installing nut is used to fit an adaptor on the installing tool. Various standard light weight auger drive units or impact tools with special sockets will accomplish installation speedily.

Design. While the figures given in Table 1 cover most conditions where hold-down is required, specifications for anchoring must be drawn up to suit varying conditions in each construction project. Where high shear strength hard-pan or sand is encountered at trench depth, and the anchors produce greater than nominal holding capacity, smaller diameter anchors may be used. In unusually low shear strength soil at trench depth, longer anchor rods or extensions may be desirable to reach satisfactory anchoring soil or the spacing of the anchors may be reduced, thus reducing the potential load on the anchors and providing the desired safety factor.

Any system of soil classification for anchor holding capacity should be based on field tests. These tests can be carried out in several ways. The fastest method is use of a special screw type probe, which registers the torque required to force it into the soil, indicating the shear strength and compactability of the soil. These being the factors which constitute the holding capacity of an anchor, they are correlated with the known capacity of a given size anchor installed to a minimum vertical depth.

The common method of obtaining soil samples by boring to anticipated installation depth may be used. Anchors may be installed to normal depth in sample locations and test pulled. Sufficient safety factor should be allowed to compensate for variation in the holding capacity between test sites. The amount of testing to be done can be adjudged from such indicators as variations in topography, general soil composition and natural vegetation.

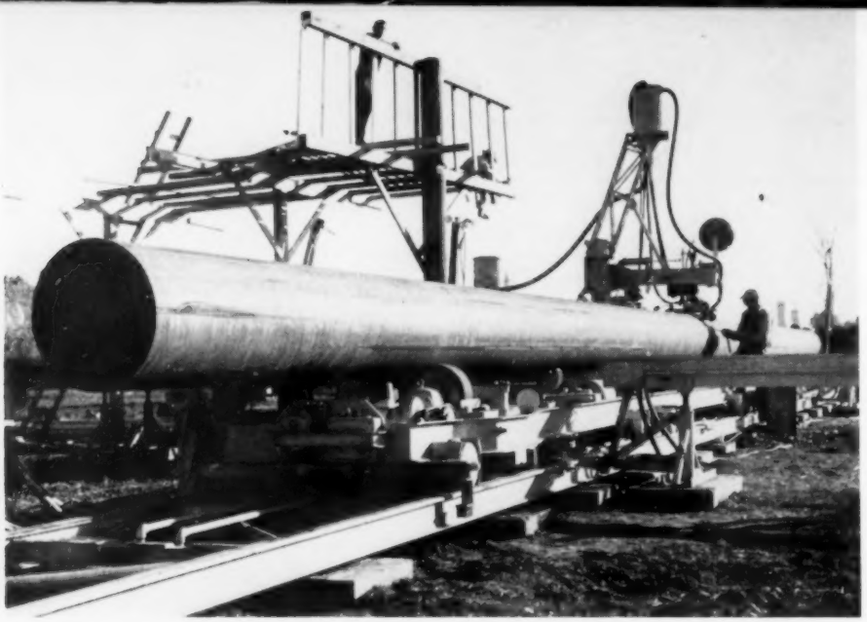
As a pipe line tool, mechanical anchors have been advancing rapidly in recent years, and it is quite likely that quite a few of the 25,000 miles of pipe to be laid this year will be held in place by screw-type mechanical anchors. **—The End**



Cross-section of the final installation prior to backfill. These anchors are effective even in poor soil.

About the Author

W. L. Hollander, professional engineer, A. B. Chance Company, has been active in earth-anchor engineering, development, and testing for 30 years. A registered professional engineer in the state of Missouri, he is a past president of the Missouri Society of Professional Engineers. Hollander received his degree in mechanical engineering from the University of Missouri. For the past several years he has spent a considerable amount of his time making a detailed study of the possible uses of several types of mechanical anchors on underground pipe lines.



Over-all view of double jointing process shows welding machine's flux hopper, metal rod spool and welding head supported by rollers. The overhead shelter under construction will allow Bechtel to operate under any kind of weather.

Double Jointing Without Internal Pass or Tack Weld

Bechtel's automatic and completely submerged arc process makes weld in five minutes with only two passes. New line-up clamp and fiber glass tape eliminate need for internal pass

By Donald G. DePugh
Construction Editor
PIPE LINE INDUSTRY

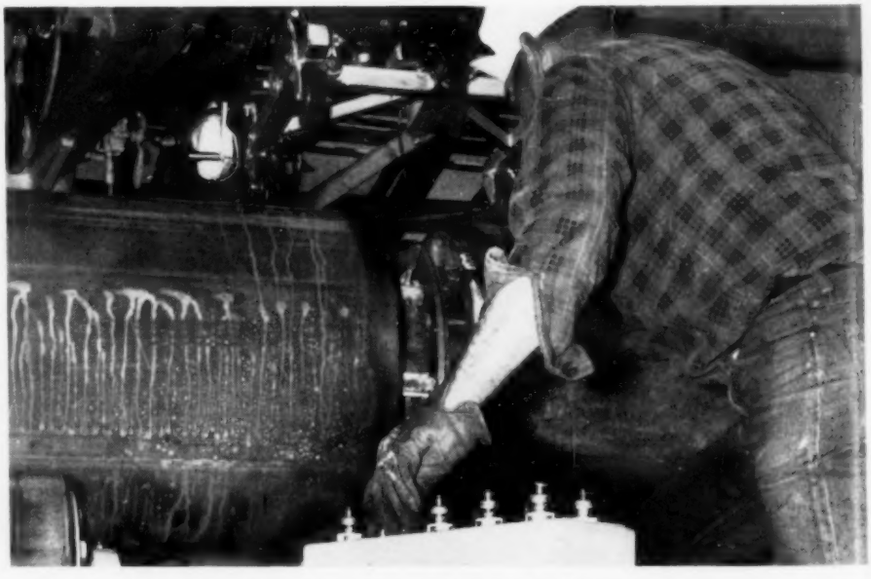
ELIMINATING the internal pass, tack weld and all-manual welding marks an important advance in automatic welding methods. Bechtel Corporation recently introduced a revolutionary automatic and completely external process of submerged arc welding at its double jointing plant in Baton Rouge.

Bechtel's double jointing machine uses a new line-up clamp incorporated with a fiber glass tape to guide the root bead and eliminate the internal weld previously used in double jointing. The pneumatic line-up clamp is equipped with segmented copper shoes which expand to cover the entire inside circumference of the pipe. Pliable fiber glass tape is fastened around the shoe and fits to the contour of the joint producing a smooth interior finish to the root bead. The sleeve also protects the copper shoe against burning; by containing the molten metal as the weld is made, it eliminates the possibility of cold laps and notching. A new tape strip is used on each weld.

Dogleg Compensator. One of the novel features of the Baton Rouge plant is a "dogleg compensator" which allows for any bends in either pipe joint as they are rotated during welding. This compensator's main function is to assure a fixed spacing at the weld point. It consists of two rollers set on cushions and a variable preset eccentric friction drive to absorb any difference or offset in the pipe rotation caused by pipe bends. After the line-up is made the compensator is locked by the operator and maintains a fixed gap as the joints are welded.

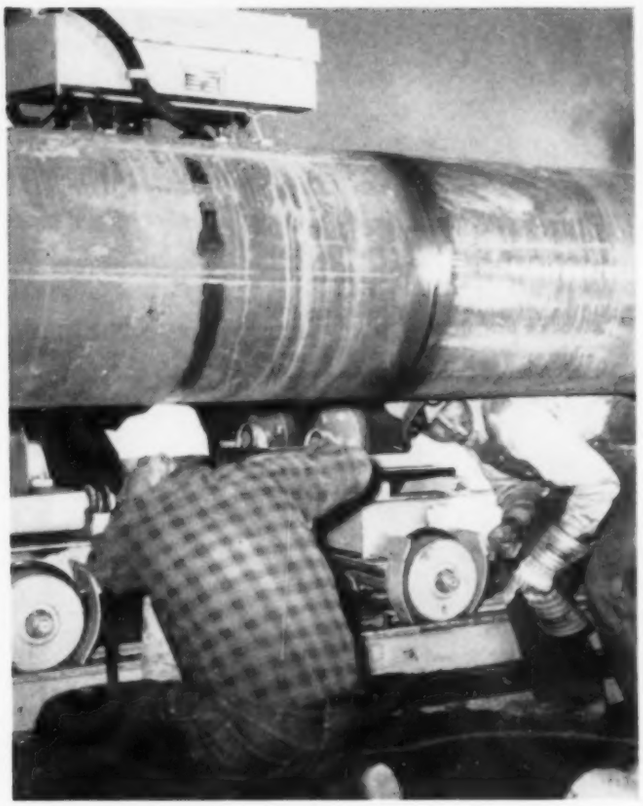
Bechtel's automatic welding head is designed to automatically control the length of welding rod extending from the spool to the welding point. The "floating" head is supported by a mechanism which provides for both vertical and lateral movement; this insures a precise distance from center of pipe to the weld. Any movement in the joints is allowed for by the supporting rollers.

The conventional welding machine is supplied by a 750-ampere generator. Approximate thickness of welds made on the 24-inch, 5LX-52 pipe

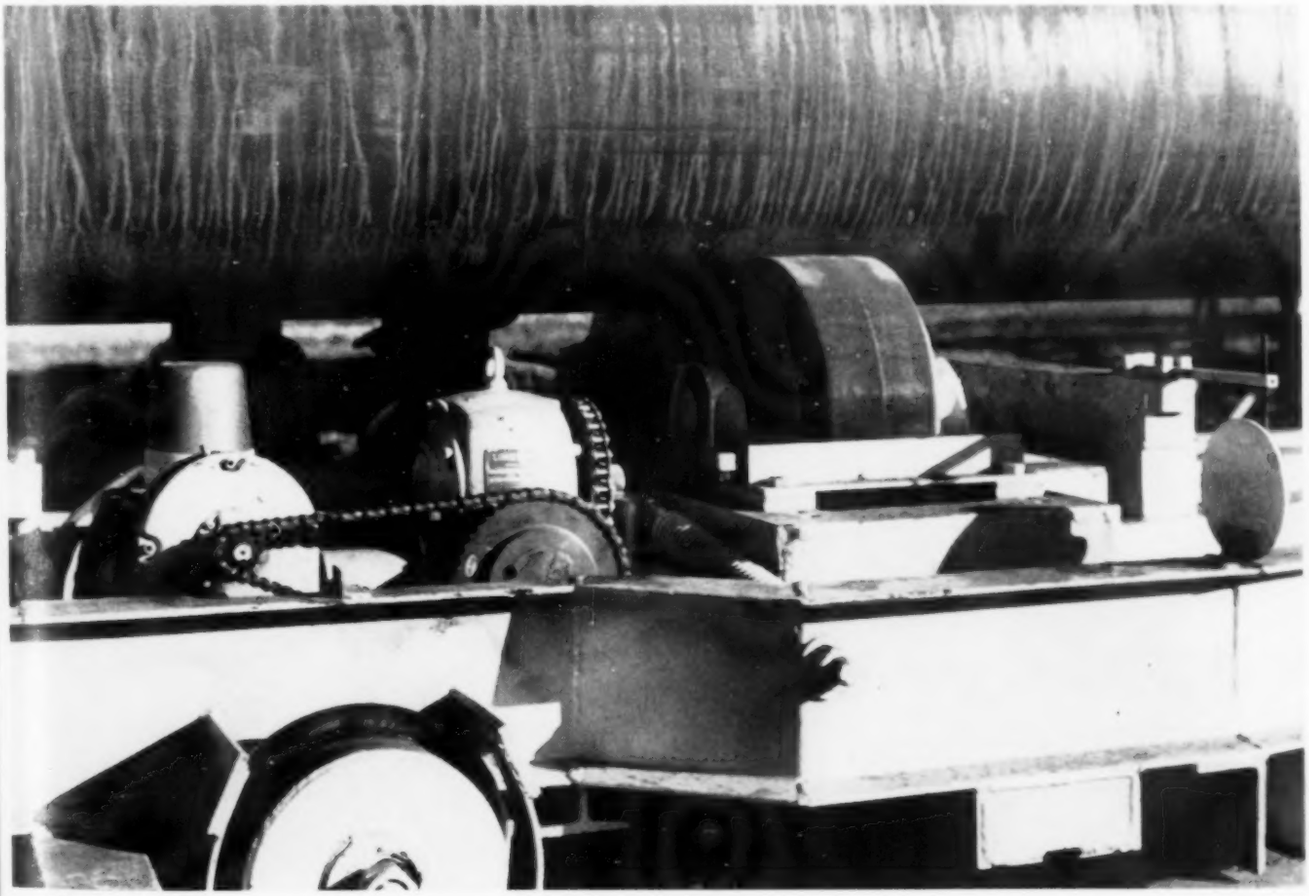


Operator guides joints into the welding station. All adjustments for final line-up are made with the control panel in foreground. The line-up clamp is inserted in joint on right before moving to the welding station.

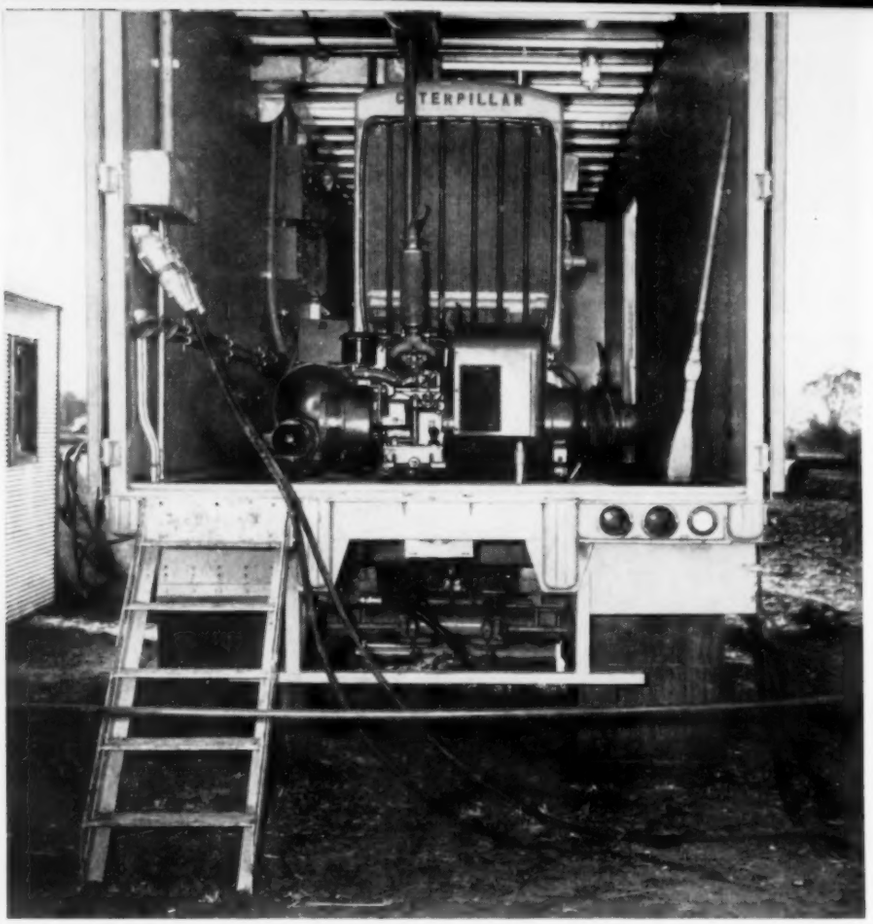
Pipe rotates slowly as first pass is made. Flux overflow is recovered and brought back to flux hopper and slag is cleaned off welded area. Pipe is rotated faster during second pass; complete weld takes approximately five minutes.



The 80-foot joint is tripped onto a storage rack after the second and final pass has been made. Double jointed pipe moves to the X-ray station and then is carried to storage racks. Welds meet or exceed all code requirements.



One of the unique features of Bechtel's double jointer is the "dogleg compensator" which consists of two rollers set on cushions and a variable preset eccentric friction drive to absorb any difference or offset in the pipe caused by bends. After line-up is completed this compensator is locked to maintain a fixed gap as joints are welded.



A 100-horsepower diesel engine driving the welding generator, an air compressor for operating pneumatic jacks and line-up clamp and a spare welding machine are all centered in one trailer. The entire plant is mobile and can be moved easily from one location to another.

with a 0.312-inch thickness was $\frac{7}{16}$-inch. Weld metal builds up about $\frac{1}{16}$-inch inside and outside of pipe joint.

Joints of pipe are guided into the welding station by the operator who controls both sleds and the compensator. He regulates all movement of the pipe by means of a control panel consisting of 10 switches to move pipe to the welding station, set the compensator and make adjustments for proper line-up. Only 12 men are needed to operate the entire yard, excluding maintenance and supervisory personnel.

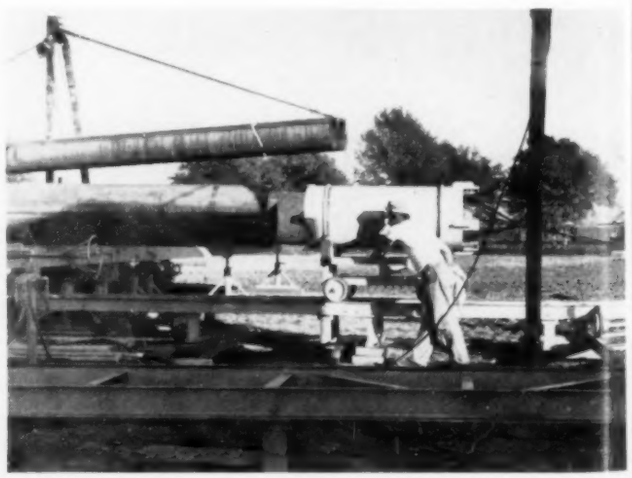
85 Welds Per Day. The new submerged arc process completes a weld in about five minutes, making only two passes. Using only one station, Bechtel was making 85 welds per day double jointing approximately 90 miles of 24-inch as a subcontractor for Oklahoma Contracting Company for a Coastal Transmission Corporation spread in Louisiana.

The plant is set up to double joint pipe from 20 to 36 inches in diameter. Pipe advances to the buffing, line-up and welding stations by pneumatically operated jacks. After the weld is made, another jack trips the 80-foot joint onto a storage rack; from there it is moved to the X-ray station. On this job for Oklahoma, 100 percent of the welds were X-rayed with excellent results. From the X-ray station pipe is moved to storage racks and is ready for stringing on the right of way.

Plant Is Virtually Portable. All necessary power equipment is housed in one trailer. This includes a 100 horsepower diesel engine driving the welding generator, an air compressor for operating jacks, switches and line-up clamp plus a spare welding machine. The extra welding machine enables Bechtel to set up a second station on large spreads to speed construction. A shelter to extend over the welding machine is being constructed so that it may be used in any kind of weather.

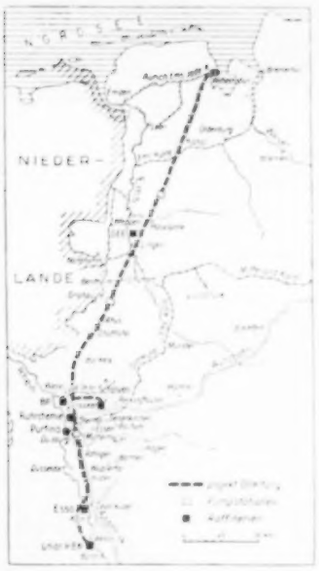
Shifted Along R.O.W. Bechtel's plant can be moved from location to location to reduce handling of double joints and provide further welding economy. It is designed for easy disassembly, transport and reassembly. Next step is to improve mobility for possible right of way usage.—**The End**

To speed welding operations, a double cable is used on the sideboom to move two joints at a time from the storage rack to welding ramps. Ends of joints are cleaned and buffed before passing to the line-up post.



This specially designed dolley inserts line-up clamp and retrieves it after weld is made. After inserting line-up clamp in joint, it moves to welding station on tracks at far right. Handle of clamp is seen at far left as weld is being made.

Welded section of 28-inch pipe is walked into position for weld on one of six spreads working through the German countryside between Wilhelmshaven and the Ruhr. Pipe was yard coated with an asphalt, fiberglass, asbestos outerwrap system and section welded. Across this type terrain spreads often made good daily progress of 2 kilometers or better.



Route of the 28-inch crude line from the North Sea port of Wilhelmshaven to Ruhr refineries. In initial operation one pump station at the North Sea terminal will move crude; plans call for future additions to this station and three new stations at intermediate points on the line.

Europe's Longest Big-Inch Line Starts Operation

German contractor used modern methods in laying the 230-mile, 28-inch line from North Sea port of Wilhelmshaven to the Ruhr

By **Omer Anderson**
Bad Godesberg, Germany

IN COMPLETING Europe's largest crude oil system in less than a year the contractor, Ruhrgas AG, Essen put to use some of the latest ideas and equipment to average better than a mile a day. A number of waterways, roads, underground piping and cable installations plus cultivated German farmland had to be crossed and restored.

Initially the line, operated by Northwest Oil Pipe Line Company, will deliver up to 200,000 barrels a day to Ruhr refineries. Plans call for ultimate expansion with three unattended pump stations to boost capacity to nearly 500,000 barrels daily.

Construction of the 230-mile system required the crossing of the Rhine, Ems, and Lippe-Seiten Canal plus numerous smaller water crossings. At each of the major waterways, a ditch was dug across the bottom of the channel and the completed concrete coated pipe string was walked or strung across.

The line was laid by six spreads working simultaneously; on good days they made up to two miles a day across smooth terrain and clear right-of-way. Grade X-52 pipe was used for the 28-inch main line and refinery delivery

Tanker unloading terminal located 2,300 feet from shore at Wilhelmshaven is supported on driven piling 110 to 140 feet in length. Hydraulic powered legs permit raising and lowering the dockside piping facilities as necessary. Originally designed to accommodate three tankers, it will ultimately be able to handle six, including docks for four supertankers. Channel was dredged to a minimum depth of 50 feet, but the port will take vessels with 60 foot drafts at high tide.

Dual crossing is lowered into the Ems River Bed by barge mounted cranes. On all major waterway crossings ditch was cut in the bottom and the completed concrete coated pipe strings lowered in and backfilled.

laterals; wall thickness varied from 0.31 to 0.468-inch according to pressure requirements.

All pipe is being protected with a coat and wrap system plus cathodic protection. Yard-applied protection consisted of sand blasting, asphalt coating, fiber glass and asbestos outer wrap. A jacket of concrete weight coating was applied on river pipe.

Where the line intersected other lines, roadways, or electric, gas, water or communications conduits it was cased and insulated. A minimum of three feet of cover was specified for all land sections; river crossing trenches were backfilled.

Automatic Control. At present the line will move crude with only the single, 6,000 horsepower pumping station at Wilhelmshaven. Addition of three remotely controlled and unattended stations at intermediate line points will boost capacity to an ultimate of 500,000 barrels per day.

All operations are now controlled from the Wilhelmshaven control center; future stations will also be operated from this point. Pressure gages and controls are connected into the master control panel in such a way that the operator can control flow and pressures in any section of the line from Wilhelmshaven. Maximum operating line pressures will be between 880 and 1,000 psi.

Plans call for future addition of a 10,000 horsepower, 4-unit station at Gronau in 1960; two new 4-unit, 9,000-horsepower stations are to be added at Ostenwalde and Duisburg in 1965. When these capacity increases are made, additions of 11,000 and 14,000 horsepower are to be made at Wilhelmshaven plus additions at Gronau totalling 10,000 horsepower in 1965.

Tank Farm Design. Initially the Wilhelmshaven terminal will have 14 tanks, each of 200,000 barrel capacity. Space is provided for adding up to 34 similar tanks if future expansions demand.

Welding a section of the 230 mile line in German timberlands. Welding machines were mounted on light track vehicles to speed cross-country leapfrogging. Field welds in the X-52 pipe were inspected by x-ray and isotope inspection methods.

Tanker storage terminal at Wilhelmshaven began initial operations with fourteen 200,000-barrel tanks. Space is provided for additional tankage that could boost storage to nearly 4,000,000 barrels. Thirty-inch unloading lines carry crude from the tanker docks to tank farm. Tanks are equipped with electronic remote gaging and temperature reading instrumentation.

Casing being laid for road crossing; note well points holding soggy bank of ditch. At all intersections with roads, railroads, other pipe lines, power, water, and communications conduits the main line was cased and insulated. The entire system is coated and wrapped and will be protected with a cathodic protection installation.

Preparations being made for the dual crossing of the Rhine near Leverkusen. There were numerous water crossings on this job; spectators gathered to check progress on Germany's longest big-inch crude line system.

Ditcher moves through German farmland; through most of the terrain crossed the ditch held up well and progress was good. A minimum of three feet of backfill was specified for the cross-country sections of the Wilhelmshaven to Ruhr pipe line system.

All tanks are to be equipped with electronic remote gaging and temperature reading instrumentation. Remote operation is provided for motorized valves at the tanks and on the tank farm manifold.

Two 230-horsepower booster pumps on the tank manifold provide suction pressure to the main line pump and for transfers. These are remotely controlled. Ultimate capacity additions will require installation of booster pumps at each tank.

Tanker Unloading Terminal. Construction of the pipe line system actually comprised two projects—the pipe line and station itself and the specially designed tanker terminal offshore. Instead of a fixed height pier, engineers borrowed ideas from marine drilling platform design. Eight adjustable legs allow the dockside facilities to raise and lower on hydraulic powered legs.

The dock is located some 2,300 feet from shore; a channel was dredged to a minimum depth of 50 feet or 60 feet at high tide. Support for the novel offloading dock is provided by driven pilings of 110- to 140-foot lengths. Three tanker berths are provided with provisions for three more to be added later. Supertankers of 100,000 ton capacity are not expected in early operation but four of the berths will be able to handle them in the future. Thirty-inch unloading lines will allow unloading rates of up to 40,000 barrels per hour to the tank farm.

Dock facilities were constructed by the engineering firm of Dr. Agatz Nachfolger; the tank farm was built by Dorsch-Germann.

Refining companies who joined to form the Northwest Oil Pipe Line Company to build and operate the line included Esso AG, British Petroleum AG, Purfina Mineraloelraffinerie AG, Mulheim Ruhr-Speldorf, Scholven-Chemie AG, Gelsenkirchen-Buer, Union Rheinische Braunkohlen Kraftstoff AG, and Ruhrchenie AG.

—The End

Right of way work through German countryside. In good terrain spreads made up to two miles a day; average daily progress for the six land spreads was better than a mile. Latest ideas in equipment and methods were used.

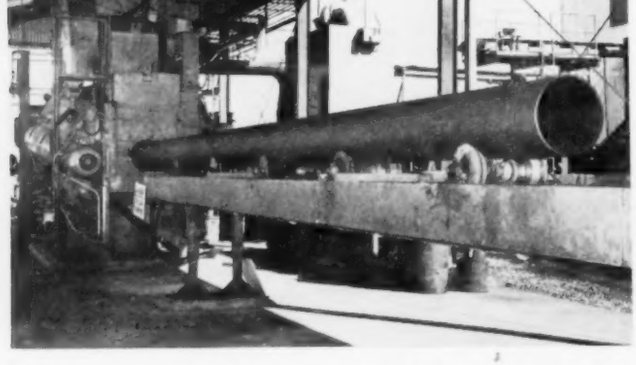
Blending of a dry mix of sand, barite aggregate, barite fines, and limestone fines is prepared in pug mixer (center) before hot liquid asphalt is added. Barite and sand, shown piled in foreground and at right, enter the dry mixer via belt conveyor. Limestone fines are blown in by pipe at left, from storage tanks not shown. After dry mix is completed, asphalt is added at 360° F. Liquid rubber and strands of glass are added before coating is applied to pipe.

Automatic Yard Speeds Weight-Coating

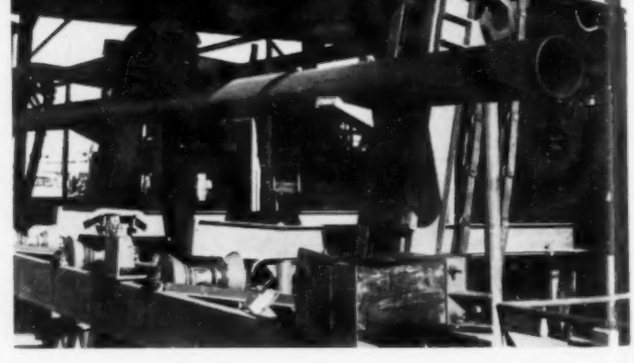
New methods include wash with light oil for primer, thin muslin outer wrap and white wash to produce tough and heavy asphalt-mastic coating

IN DEVELOPING a highly automatic asphalt-mastic weight coating plant, Southern Natural Gas Company and Brown & Root, Inc., have made important strides in increasing production and getting better controlled protective-weight coating for submarine pipe lines.

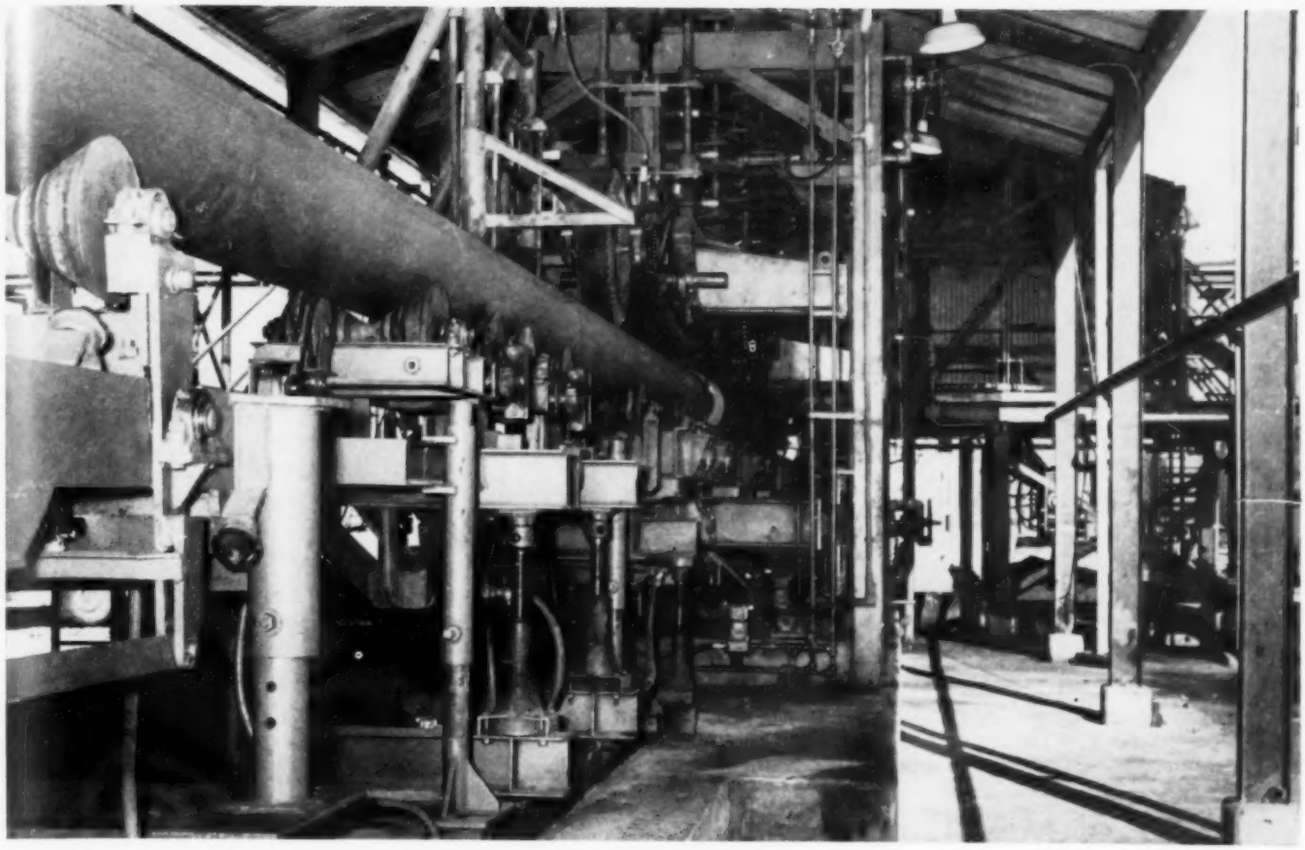
With production averaging 300 joints of 12-inch pipe per day, the yard coating process offers many advantages over a similar method formerly used on a barge (PIPE LINE INDUSTRY, December, 1956, Page 20.) Operated by Timcoat Corporation, the $2 million plant at Belle Chasse, La. is designed to handle pipe up to 26 inches in diameter.



Pipe passes through drying oven and cleaning and grit-blast machine before the asphalt-mastic coating is applied. The plant is designed to coat pipe up to 26 inches in diameter. Timcoat has averaged 300 joints of 12-inch pipe per day.



Joints are handled throughout the process by power driven conveyors. After joints are cleaned, a jack transfers the pipe to the collar station where a collar is applied to protect ends of pipe from being coated.



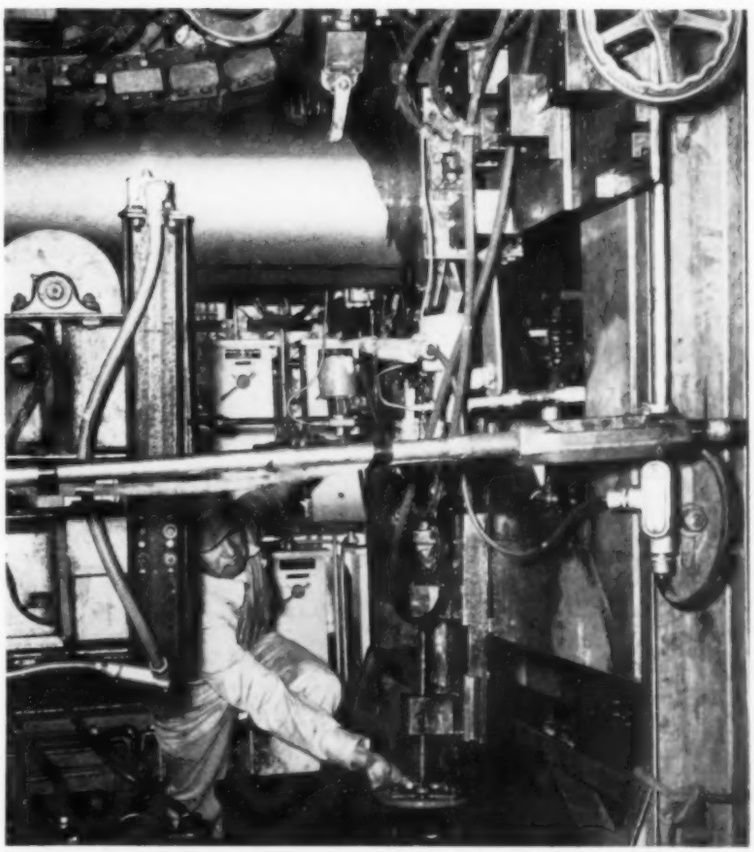
After pipe leaves the collar station it is conveyed to the extrusion hopper. Friction driven rubber tires speed up pipe movement on way to coating machine. Joints under 12-inch can travel through extrusion machine at a rate of 45 feet per minute.

New methods include the use of a light oil wash instead of a primer coat and the addition of a thin cotton cloth outer wrap with a lime white wash. The wash of light weight oil is flooded over the pipe before the joint passes through the extrusion hopper.

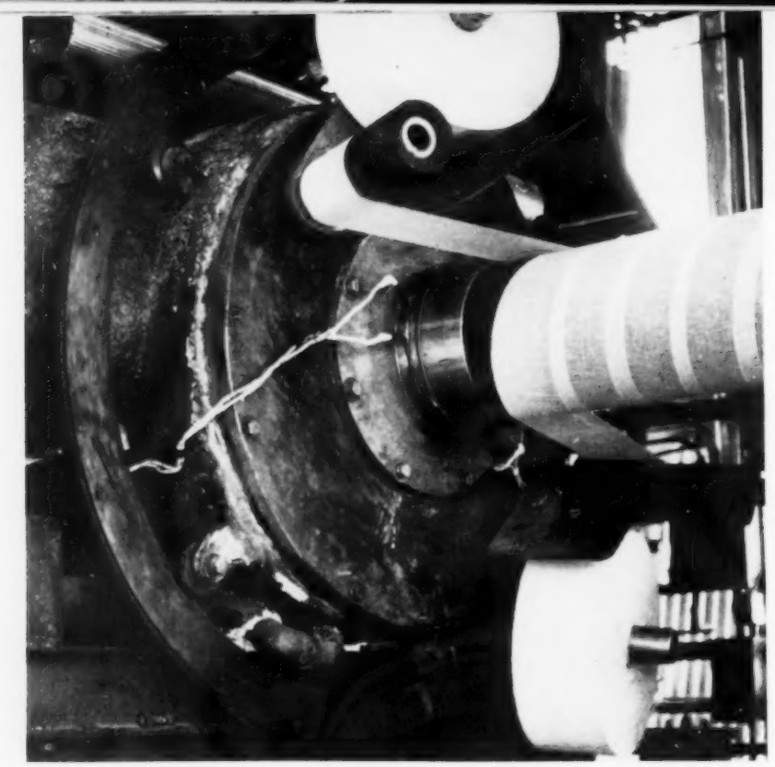
Dry Mix. First step in the process is the blending of a dry mix of sand, crushed barite aggregate, barite fines and limestone fines in a 6,000-pound pug mixer. Liquid asphalt is then added at a temperature of 360° F. after dry mix is completely blended. Heavy coating material then goes to an 18,000-pound capacity surge hopper where liquid rubber and strands of glass are added.

The surge hopper is heated by hot circulating oil; temperature is kept at 300 to 325° F. When the yard shuts down, coating is stored in the surge hopper to allow operations to start up again without waiting for coating to be mixed. From the heated hopper the coating passes to a second hopper directly over the extrusion chamber before being applied to the pipe.

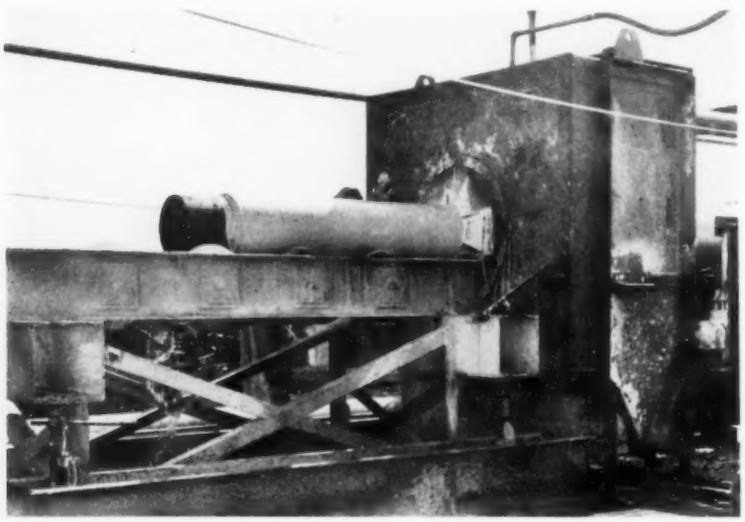
Collar Protects Ends of Pipe. Handled by conveyors throughout the



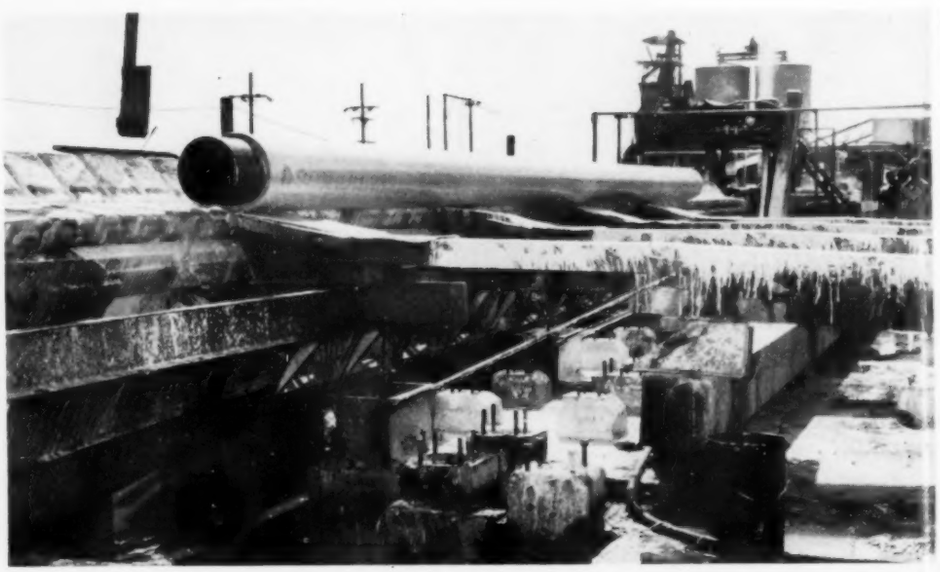
Eliminating the primer coat, a light weight oil wash is applied to the pipe immediately before the coating is extruded. Asphalt-protective-mastic weight coating is applied at a temperature of 300 to 325° F.



A thin outer wrap of cotton muslin is applied to pipe as it leaves extrusion hopper. Cloth shrinks as pipe passes under four 60-foot water sprays and keeps the coating dense.



At end of shower baths, joint is given a white wash to protect coating against the sun. Timcoat plans to add another station to cool pipe internally.



As pipe reaches end of conveyor system, it is automatically tripped onto a loading rack. When joint reaches this point it is ready for use and can be loaded onto barges and carried to job site.

process, pipe first passes through the cleaning and grit-blast machine and proceeds to the collar fitting station. Collars are slipped over the ends of the joints; field jointing can then be applied by conventional methods. After a thin coat of lightweight oil is flooded on the pipe, asphalt-mastic weight-coating is extruded onto it as it moves through the coating machine with a 25,000-pound thrust. Two six-foot long screws, positioned parallel to the joint, push the coating into the extrusion head and onto the pipe. Thickness of coatings may be varied from 7/8-inch to 2½ inches depending upon pipe wall thickness and negative buoyancy specified.

Water Cooling and White Wash. As the joint leaves the coating machine, an outer wrap of cotton muslin is spiralled around the weight coating; pipe then passes under four 60-foot long water sprays. This water wash cures and cools the weight coating and causes the outer wrap to shrink, further strengthening the bond to the pipe.

While the coating is spray cooled externally, the pipe is cooled internally by playing a hose stream inside. Timcoat plans to add an automatic internal cooling station later. Final application to the pipe is a lime white wash to protect coating from the sun during storing and laying. When a joint reaches end of the conveyor system it is automatically tripped onto the loading rack; it is then ready to be taken by barge to the submarine right of way. —The End

Beware These Human Relations

Sometimes human relations can be dangerous . . . and here are three popular "fantasies" which can cause serious personnel trouble

"HUMAN RELATIONS" is a relatively new concept which has not fully emerged from the industrial and social situation which has given rise to it.

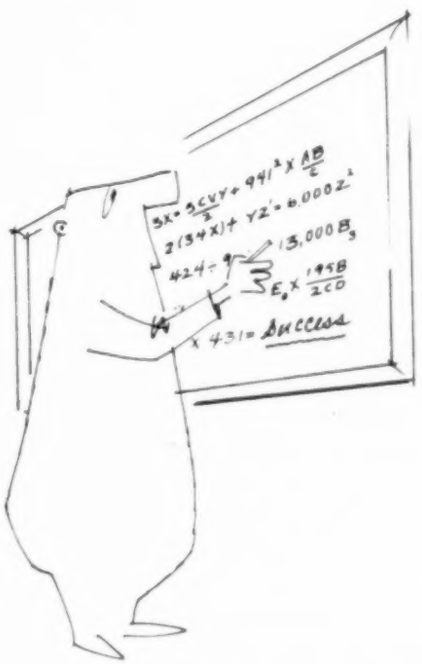
Upon searching the dictionary and the literature we find it has no clear-cut definition. If we were to depend upon the terms "human" and "relation" to describe it we would be in the position of the college freshman who wrote a term paper on "Indian basketry" by combining a digest of a Book of Knowledge article on "Indian" with another article on "basketry."

Nevertheless, human relations is continually being defined by the process of judicial inclusion and exclusion in the analyzing and solving of specific industrial relation cases and controversies.

Out of this realistic treatment of concrete cases has developed an understanding of the limitations of human relations principles. It seems, however, that there are many individuals who have not profited by this industrial experience and are still trying to reduce all of the working principles of human relations to one set formula; or one "key," or one "secret."

However, in reducing human relations to a single conclusion, there is the danger of becoming impervious to new findings which do not support it. It saves a great deal of thinking and reasoning to overlook other facts which tend to contradict the conclusion.

These conclusions which are based on some fact, some crystal balling, some wishful thinking, but which cannot be reconciled with the actual happenings in industry today, can be described as "fantasies." And, as such, are dangerous to the supervisor, the executive, and to the worker. These fantasies are responsible, in some measure, for the malady that troubles many personnel departments.



Pick out a "key to success" and succeed.

Fantasy #1. *Pick Out a "Key to Success"—and Succeed*—The originators of these well-meant but unrealistic dogmas would get a shock and a practical education if they were little mice sitting under a drafting table or behind a machinist's lathe while the worker read, and commented upon, the unfailing "key to success" that had just been distributed by the supervisor.

The worker's first comment is generally upon the illustrations. The pamphlet asks, "Which way do you want your employe to look?" There sits one worker at his stamping press, singing and smiling, while his machine produces 10,000 ash trays per day. His supervisor has used the unfailing human relations formula on him. Nearby, sits a second press operator. He is unsmiling. He is drooped. He is unhappy. He is not singing. His press is not singing. In fact, it is not even humming. He produces only 8000 ash trays a day. His supervisor has not used the formula on him.

The sad sack at the second stamping press doesn't worry our worker very much. He looks familiar. Our worker identifies with him. But that smiling, singing, rascal. He's the fake. Our worker hates him. Our worker knows that realistic human relations principles used in the proper doses and at the proper time will increase production and raise morale.

But, it will not make a press operator jump up and click his heels every morning when he is handed his working order for the day that calls for 10,000 small, identical, tin ash trays to sell for 10 cents each.

It is easy to understand why the supervisor, and the worker himself, is constantly seeking some one-shot formula, some technique, or some procedure which will solve the human relations problems. The supervisor wants to spend more time on production and he feels that time spent on solving human relations problems appear to reduce the time he has for his "more important" problem of meeting production goals.

The worker wants to get ahead. He wants more money. He wants to

"If I believe I can, I can"

"amount to something." Experience in industry shows, however, that there is no set formula or device that will cure the supervisor's ills or help the worker reach his aspirations. And most people who look at human relations realistically are quite sure that no such formula can ever be developed.

One fact that prevents the establishment of a set formula, is that change in industry is inevitable. Competition in a democratic country forces each enterprise to change, modify and increase or decrease its facilities. For example, a human relations formula which would work before the days of automation is no longer applicable in many respects.

Another fact is that some formulas, modified to meet changing conditions, can work in certain companies but cannot be automatically applied to all other companies. They must be changed to fit the working situations of each company. One can even go farther and say that some plans can work in some departments of an industry and not in other departments.

Let us take a look at two or three of these one ingredient formulas. While we are looking them over we will consider some facts related to them.

Take for example the cut and dried formula that guarantees promotions and raises if you "prepare" for them. For many a worker it is too late to "prepare." And many times this is no fault of his. His schooling was interrupted by the war. Or other obligations and responsibilities forced him to obtain work, and remain at it, before he could adequately "prepare" himself for future promotions and raises.

Whether human relations formula writers know it or not, there are many jobs in American industry that are filled with employes who find themselves, when it is too late, unprepared. Small wonder, then, that many workers are unhappy and spend much time and effort rehearsing their grievances. Yet, and even the worker recognizes this, this occupation of self pity is plainly not healthy.

Many critics point a stern finger of reproof at these employes. They do not waste time with details. If these employes are unhappy in their jobs, the critic admonishes, they should get out of them as fast as they can. Or they should stay in and, on principle, keep quiet. If they stay in, the critic continues, they must like their jobs, else they are crazy. Because no sane employe would remain long in a job he dislikes.

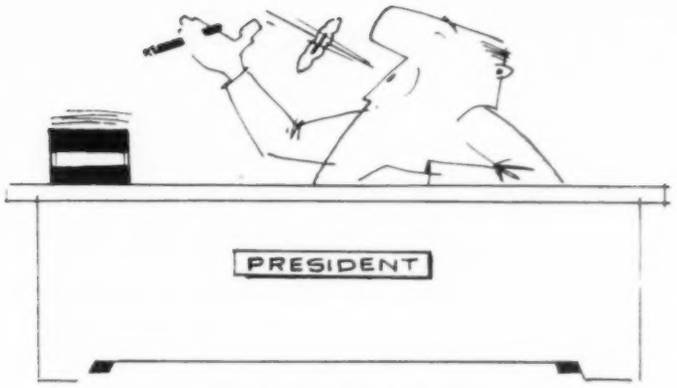
These critics must be pulling our legs, since the bland assertion of the preposterous is an easily recognized sort of humor. And it is preposterous to think a man is slightly deranged to remain in a job he dislikes. The woods are full of this sort of employee. It is much better to counsel him on ways of finding enjoyment outside his job.

For we must realize, of course, that there is no such thing as a perfect job. Every job his its good points and its bad points. One must be weighed against the other. If the employe feels that he is not getting necessary satisfactions from his daily job, there is something constructive he can do about it.

When the employe sees that he has reached a dead-end as far as promotions and merit raises are concerned and he still yearns for an opportunity to exercise his real talents, it's time for him to look around for an avocation. An off-the-job activity that will give him the pleasure of doing what he thinks he was meant to do. The employe who knows he has some organizational and executive ability, but has no opportunity to use it in his work, can organize community projects and turn in his ability to an excellent purpose.

Fantasy #2. *"If I Believe I can, I Can"*—Few down to earth, hard working employes are going to swallow the human relations bit stating, "If You Believe You Can Do It, You Can Do It." An employe can believe all day and all night that he can do a certain task, but his abilities, or his intellect, or his training, or his environmental circumstances may keep him from doing it.

One is reminded of the disciple of the Behaviorist School of Psychology who stated, "Give me any child and I will make anything out of him that I care to." A colleague suggested that he go to a home for the feeble minded and secure a child with an I.Q. of 50 and make a medical doctor out of him. This, no doubt, induced the dis-



"There is no dead-end job"

ciple to make more realistic statements and to leave the fantasies to others.

For the employe who believes the fantasy, "If I believe I can, I can," there are no limitations. If the problem is to type 120 words a minute all the individual has to do is believe she can and she can. Such fantasy is bad, because it is not true. The abilities of each person are limited. This was so in the past and will remain so in the future. This fact is part of life and realistic human relations strives to cope with it.

Fantasy #3. *"There Is No Dead-End Job"*—"There is no such thing as a dead-end job, unless it be the top position of the company." A few statistics will prove that statement to be a fantasy. A fourth grade teacher once told a class of 40 students that, "Everyone in this class can be President of the U. S." Not counting the mentally deficient and otherwise handicapped members, we can see that numerically it would be impossible. By the same token, all the employes cannot go up to the top position of a company.

There are other reasons for dead-end jobs, too. In most organizations there are specific requirements that must be filled to advance to bigger and bigger jobs. Some employes just simply cannot fulfill these. And no matter how valuable they are to the company in their present jobs; no matter how hard and conscientiously they work; no matter how much ability they have; if they cannot fulfill the requirements they have a dead-end job.

"But," the originator to fantasy No. 3 says, "if the employe will prepare himself he can fulfill the requirements." It is difficult to see how a 40-year-old draftsman with three children in public school and one in college can afford to quit work, return to the university to complete two more years of engineering for his B.S. degree so he can advance from draftsman to engineer.

And it is very unrealistic to say, "If he had done so and so before he was married . . . " We cannot back up. We must recognize the fact that we cannot neatly set aside this common problem by postulating a cure-it-all solution such as fantasy No. 3.

Many times, for good or bad, an employe is stuck with his job. The thing for us to point out to him is that he can, thank goodness, choose his avocation. This avocation can provide a lasting interest through the years, giving him a constructive, deeply satisfying activity long after it is no longer necessary to have a full time daily job.

Such human relations counseling is more realistic than the "fantasies" passed out daily to the employe. And if we are to use realistic human relations instead of fantasies, we must accept as a realism that good human relations is based on judgment. Formulas and "keys to success" are important as tools and guideposts for action, but judgment is still required to select the proper formula or key to success and to make the proper application of that human relations formula to a specific situation.

The basing of human relations on a set formula without judgment is an over simplification. Such an over simplification is dangerous because the individual who practices it in every situation will find it back-firing on him.

None of this discussion implies that principles and formulas must not be formulated. It does imply that they must be used with discretion. For industry, under the pressure of the influence of competition has made many changes. These changes, particularly those resulting from the general acceptance of changed supervisory methods, have been distinctly in the interest of the individual employe. He no longer accepts unrealistic orders and demands silently. Nor will he accept unrealistic human relations silently. He will toss such fantasies in the waste basket.

All human relations exponents, in order to escape absurdity, have to recognize that there is a negative side to life. This negative side must be taken into consideration and handled with judgment when formulating any set of human relations principles. Otherwise, the principles will be nothing but fantasies and simply will not work in the majority of cases. For the most part, supervisors and employes have a healthy skepticism which leads them to recognize such fantasies and human relations Pollyannism. This is why realistic human relations will not be smothered by the oppressive miasma of fantasies. —**The End**

PART 2

Computer Aids for the Pipe Line Engineer

Understanding application of the electronic computer in logical operations opens up many possibilities in pipe line engineering. Here is a clear approach to solution of typical problems . . . design properties of pipe and pressure drop handbook calculations

By T. R. Young
Shell Pipe Line Corp., Houston

THE FIRST PART of this article described the flowchart method for defining technical computation work, new techniques being used with computers, and some of the ways pipe line engineers can put them to work.

To amplify that introduction to computer usage, this section discusses additional flowchart elements that greatly extend its potential as a descriptive device. It will also cover use of the computer in logical operations, now perhaps the least understood field of computer application, and lead into practical examples of computer applications to pipe line engineering problems.

Computers in Logical Operations. This particular use of the computer is undoubtedly least understood by the general engineer, but it offers one of the greatest potential means of exploiting stored program computers in business analysis. For this reason it is especially important.

To give an example, take the problem of finding out whether the number 17 is to be found among a set of $[a]_i$ values initially given, i = 1(1)n. The program starts with a program entry and read of the set of numbers $[a]_i$ (Figure 6). Initial data selection is made with an initialization of i; recognizing a return to the subsequent program at a point following an initialization, a fixed connector 1 is arbitrarily provided for return identification.

The fixed connector is followed by a test of a_i against the number 17 with two branches for the test, "equality" and "inequality." If the current value of a_i is not equal to 17, the "inequality" branch is taken and a second test for completion of the examination of the data set, i against n, occurs.

Two branches from the i versus n test provide (a) recognition of completion of the examination ("equals to or greater than" branch) or (b) failure to complete the examination ("less than" branch). If all numbers have been examined and none have been found equal to 17, the operation is terminated at "OUT."

If the "less than" branch from the i versus n test is taken, indicating incomplete examination of the data set, the modification, i + 1 becomes i, is made to select the next piece of data for testing. This is followed by a return to the fixed connector 1.

During the testing of successive values in the set and upon detecting an equivalence between 17 and the current a_i value, the fact will be indicated by branching from the a_i versus 17 test on the "equality" exit. This is followed by a write of the number 17 and termination of the operation.

More Complex Logical Decisions. Logical operations of testing and branching are very simple in concept, but permit extremely complex logical decisions under automatic control in the computer when combined in more

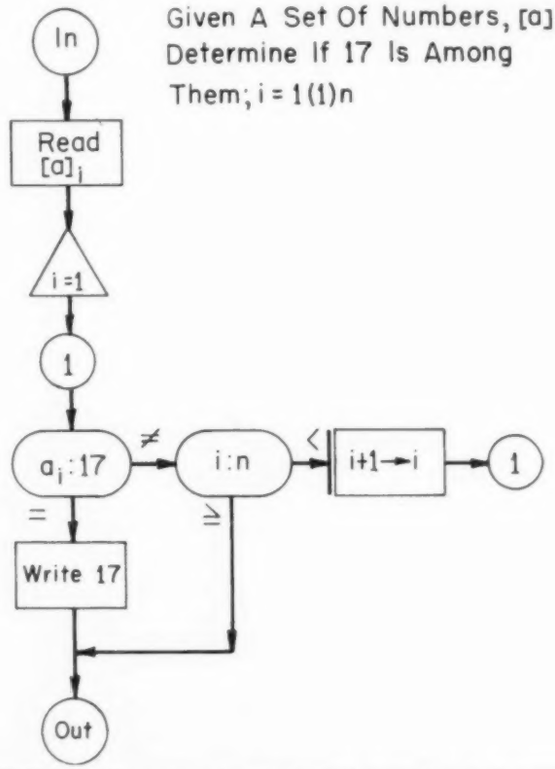


FIGURE 6—Flow chart for the logical operation of determining whether the number 17 is among a set of given values. The series of numbers will be examined with two branches for the test "equality" and "inequality". This is one of the simpler concepts in logical operations.

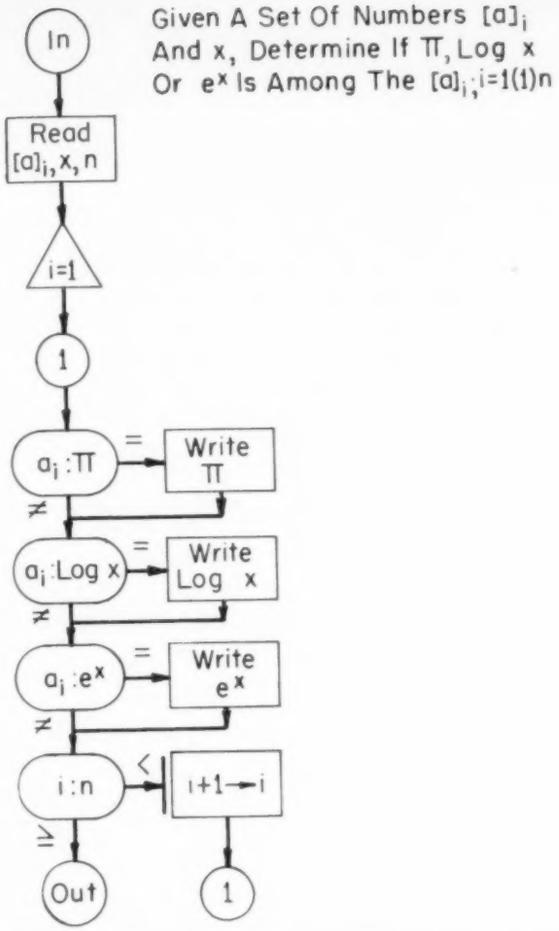


FIGURE 7—Extension of basic testing and branching for logical decisions is illustrated by this comparison operation for three values pi, log X and e^x. Again the two test branches are "equality" and "inequality", however with the three examinations being completed in series order with a write out function as each value may be found in the set of data.

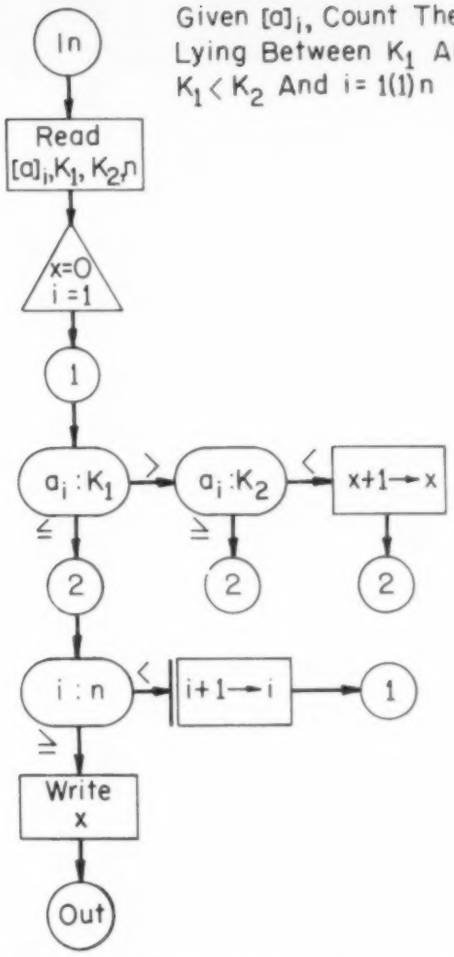


FIGURE 8—To determine the number of values lying between two arbitrary selected values a counter is utilized. The counter, designated x, tests for values of a_i between K_1 and K_2. At the conclusion of the examination of all a_i values, the tally x is written out.

elaborate structures. The logical comparison operations can be used to make many practical applications in the analysis of pipe line engineering problems.

A simple extension is illustrated by extending the previous problem to determine whether any of three values are present, pi, log x, and the function e^x. The operation is initiated (Figure 7) by a read of the full $[a]_i$ set of data plus a value for x and n, the number of values in the a_i set. This read operation is followed by an i initialization and fixed connection 1.

The a_i test against pi follows with two branches, "equality" and "inequality." If a_i is found equal to pi, the value is written as an indication of this fact and the program returns to the examination of the next comparison value. A test of a_i against log x follows with an identical pair of branches. The third examination of a_i against the value of e^x is exactly similar. A test for conclusion of the examination of the entire set of numbers, e.g. a test of i against n, with appropriate branch modification of i and return to the fixed connector 1, follows.

Simple Computations Can Be Implied Without Diagraming. Some abbreviation of the required computation is indicated here in that the value of x is read as input, but functions of x, log x and e^x, were actually required in the test. This implies prior computation of these functions. They are simple enough that the computation need not be specifically indicated in the flowchart.

Testing Numbers Against a Tolerance. Another example is shown (Figure 8) in which a series of numbers are examined to determine the number of them which lie between arbitrary values, K_1 and K_2. For this problem a counter is utilized, designated x, in which a tally is kept on those values of the set of a_i values which are found between the limits given.

It is necessary to know that K_1 is less than K_2 and that the total number of values involved is n. With this information a pair of tests, a_i against K_1 and a_i against K_2, are sufficient for determining that any given value of a_i lies within or without the range indicated.

If the value lies within the range, a count is made in the tally, x, and the next value is examined after testing for completion. At the conclusion of the examination of all a_i values, the tally x is written.

Variable Connectors and Sets. One important element in flowchart construction not yet discussed is the variable connector with its set. To show the use of this element some simple computations will be utilized involving trigonometric functions. The reader should be

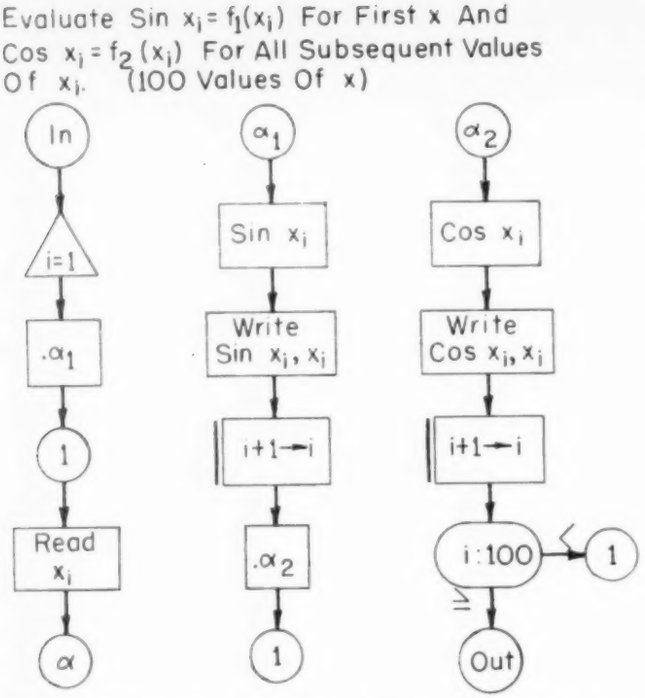


FIGURE 9—An example of the variable connector in the flowchart is shown with computations of trigonometric functions. The functions $f_1(x_i)$ and $f_2(x_i)$ could be represented by a power series for evaluation of sine and cosine functions. Slight variations in data reading and identification show some of the variations possible in flowchart writing.

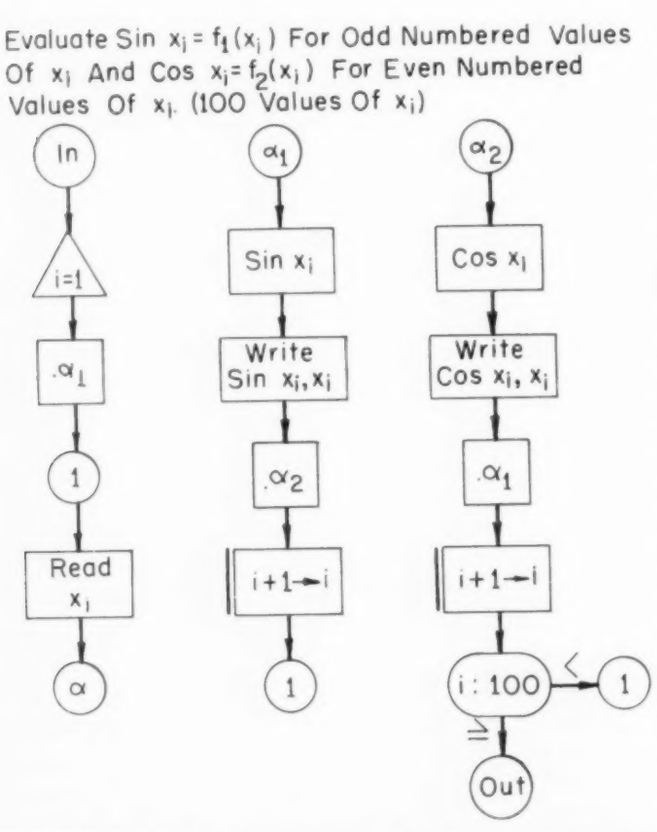


FIGURE 10—To show how active switching of computation route can occur throughout a program, the flowchart is drawn up to evaluate sin $x_i = f_1(x_i)$ for odd numbered values of x_i and evaluate cos $x_i = f_2(x_i)$ for even numbered values of x_i. This is a powerful device; the computer is essentially deciding what to do next based on the results of the current computation.

patient with the simplicity of the computations used for discussion as it is desired to focus attention on the flowchart construction itself.

To illustrate, take the problem: Evaluate sin $x_i = f_1(x_i)$ for the first x_i value and evaluate cos $x_i = f_2(x_i)$ for all subsequent values of x_i. There will be 100 values of x_i (Figure 9). The functions $f_1(x_i)$ and $f_2(x_i)$ could be represented by a power series for evaluation of sine and cosine functions and are not set forth here. A slight variation in data reading and data identification will be used here simply to show some of the variations possible in flowchart writnig.

The program starts with an initialization, $i = 1$. Since the example requires a unique computation for the first value of x_i, and a second kind of calculation for all later values of x_i, a variable connector or switch will be used. It can be set to route the computation. To calculate sin x for the first value of x_i the variable connector is set to its desired value. This is done with a box containing the notation .α_1.

This set is followed with a fixed connector 1 and a read x_i instruction. The next step is to a variable location designated alpha. In actuality there are two alpha connectors, $alpha_1$ and $alpha_2$. $Alpha_1$ will contain the once only computation of sin x.

In this sequence, the program is written calling for the calculation of sin x_i, writing of sin x_i and x_i, and modification of i. As the "once only" calculation of sin x has been completed, the switch, alpha, is now reset to its proper position for later use and .α_2 is written.

Following this set, the operation returns to connector 1 for the next data read. The previously written direction to the variable connector alpha now will go to $alpha_2$ as a result of the .α_2 set into the last step of the $alpha_1$ sequence. $Alpha_2$ calls for computation of cos x_i followed by writing cos x_i and x_i, and modification of i. As the $alpha_2$ route will be the governing route for all future computations, a test is built here testing i against 100 with branches to fixed connector 1 and "OUT."

Active Switching of Computation Route. To learn a little more about the variable connector, change the problem to the following: Evaluate sin $x_i = f_1(x_i)$ for odd numbered values of x_i and evaluate cos $x_i = f_2(x_i)$ for even numbered values of x_i. Again there will be 100 values of x_i (Figure 10). As before the charting starts with an initialization, $i = 1$, followed by a set of the alpha connector to $alpha_1$. A fixed connector return point is provided and followed by a read x_i. Program sequence then goes to alpha, previously set to $alpha_1$. $Alpha_1$ requires the computation of sin x_i and the writing of sin x_i and x_i. As the evaluation of sin x_i was just completed for the first odd numbered value of x_i, the next step changes variable connector alpha to $alpha_2$, modifies i and returns to 1 for another data read.

Following the next data read, which will be for the second and hence an even numbered x_i value, the routing to alpha will now be set to $alpha_2$ as a result of the $alpha_2$ set located in the $alpha_1$ sequence. The $alpha_2$ sequence calls for computation of cos x_i and write of appropriate data.

At the conclusion of any cos x_i computation and write, the next value will be an odd numbered value of x_i, and therefore an $alpha_1$ set is written followed by modification

of i. Also, the terminal value of 100 for i is an even number, so the test for termination of the computation program should be contained in the alpha$_2$ sequence.

This example has shown how active switching of computation route can occur throughout a program. It is a very powerful device, as the computer is essentially deciding what to do next based on the results of the current computation.

Connector Set from Data Test. Another example of the use of the variable connector shows how it can be used where the particular set of the connector can be made based on examination of data itself.

The problem can be stated: Evaluate sin $x_i = f_1(x_i)$ for all x_i less than $\pi/4$ and evaluate cos $x_i = f_2(x_i)$ for all x_i equal to or greater than $\pi/4$; again assuming 100 values of x_i (Figure 11).

The flowchart starts again with initialization of i followed by a return connector and a read instruction. A test of x_i against $\pi/4$ determines whether sin x_i or cos x_i is to be evaluated, the exits from the test block contain suitable setting instructions for alpha$_2$ and alpha$_1$.

Set instructions are followed by a direction to the variable connector alpha. Alpha$_1$ contains the sine computation and write and alpha$_2$ contains the cosine computation and write instruction. In this case it is not known whether the last value will lie in the alpha$_1$ or alpha$_2$ sequence so the program joint is made from fixed connector 2 forward. Modification of i and the test for termination of the computation is placed in this latter portion of the program.

Many Routes Possible. It should be observed that the variable connector alpha can have as many alternate routes as is desired. Two alternate routes have been used here, but many could be used in exactly the same fashion. Similarly, many variable connectors can be operative within the same flowchart.

The device of the variable connector is perhaps the most powerful device available for specifying extremely complex routing of logical and arithmetic computations under control; not only of initialized switch sets but also sets which are made by inspection of intermediate computed values themselves.

Pipe Line Engineering Applications. Simple computations have been used to emphasize the elements in the flowchart itself. Several examples of practical pipe line computations show how to use the information just developed.

For example, consider the problem of computing a table of engineering design data related to pipe physical properties. The problem may be stated: It is required to compute the following table of engineering design data for 24 pipe diameters ranging from ⅛-inch through 30 inches and of various wall thicknesses for a total of 282 different internal diameters. Inside diameter, fifth power of inside diameter, outside surface area, inside surface area, cross sectional metal area, cross sectional flow area, weight of pipe, weight of water contained in pipe, radius of gyration, moment of inertia, and section modulus.

The computation involves nine equations and approximately 6,800 calculations for the full table generation.

The following notations are assigned:

D = Outside diameter of pipe, inches
t = Nominal wall thickness of pipe, inches
d = Inside diameter of pipe, inches
A′ = Outside pipe surface, sq. ft. per ft. of length

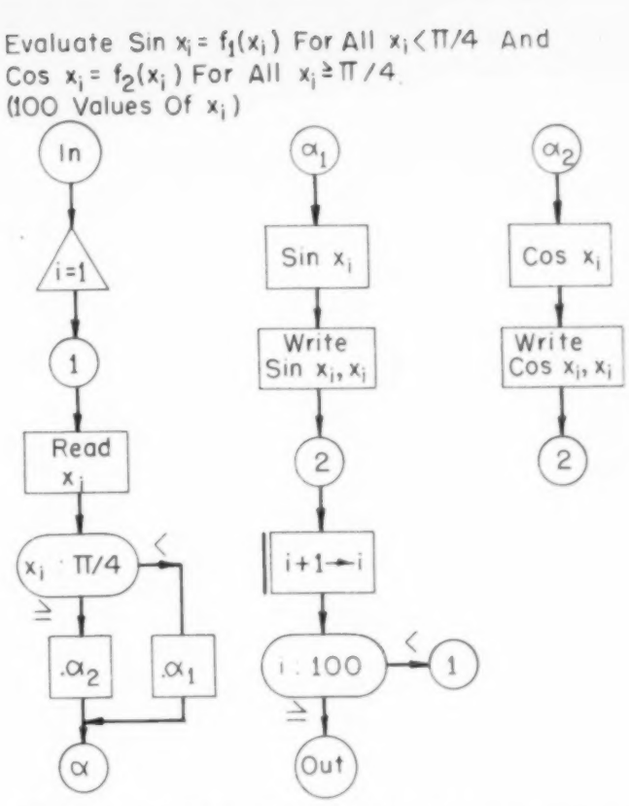


FIGURE 11—This flowchart shows how the variable connector can be used where a particular set of the connector is made by examination of the data itself. Again trigonometric functions sin x_i and cos x_i are used assuming 100 values of x_i. The variable connector alpha can have as many alternate routes as desired. Here only two routes were used. Also many variable connectors can be operative within the same flowchart.

A″ = Inside pipe surface, sq. ft. per ft. of length
A = Cross-sectional metal area, sq. in.
$\bar{A}$ = Cross-sectional flow area, sq. in.
w = Weight of pipe, pounds per ft. of length
w′ = Weight of water filling, pounds per ft. of length
r = Radius of gyration, inches
I = Moment of inertia, inches
z = Section modulus, inches cubed
Let N = the number of d values to be recognized.

All of the table entries can be computed from the two variables, D and t. The relationships required for computation are shown in Table 1.

The flowchart can be started with a read of N and an initialization, i = 1. A return point is anticipated next as connector 1 and followed with a read of input data D_i, t_i. The computation of all desired output data can be specified by writing a computation block for d, A′, A″, A, $\bar{A}$, w, w′, r, I, and z. This is followed by a write instruction for the same computed series of values, plus labeling data, D_i, t_i.

Following the write instruction it is necessary to test i against N for completion of the computation; providing both a branch for modification and a branch for termination of the computation upon satisfaction of the test.

Specifying Output Data Form. Table 1 relations plus the flowchart completely specify the desired table generation. The only remaining requirement is a specification for the appearance of the output data on a tabulation sheet.

This can be done in a short form as shown in Table 2,

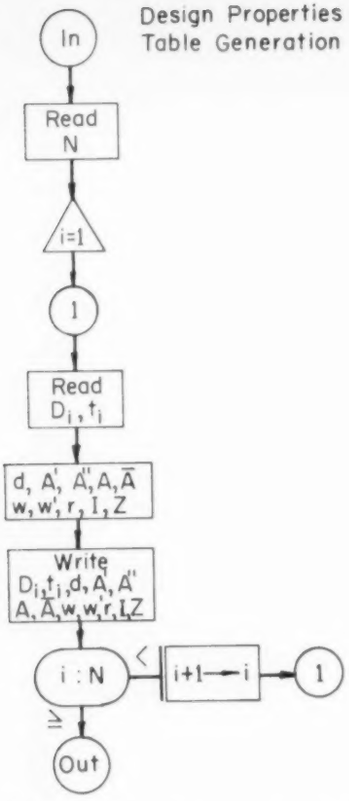


FIGURE 12—Flowchart for computing design properties of pipe, when used with the computational relations shown in Table 1, covers table generation for computer solution of this pipe line engineering problem. Output data may be tabulated in a short form as shown in Table 2.

showing the output data arrangement on the tabulation sheet as desired by the problem originator.

In this problem the flowchart permits concise specification of the desired program in a form no more laborious than that required for similar instructions to be given to clerical personnel for hand calculation.

Hydraulic Design Calculations. Now take a more ambitious problem stated as follows: It is required to compute data necessary for the construction of pressure drop curves for hydraulic design of pipe lines. The data set will include curves for 23 viscosity values for each of 60 line diameters. To cover both laminar and turbulent regions of flow, ten values of throughput will be computed for each diameter, these will then be used to determine corresponding pressure drops. The ten through-

TABLE 1—Design Properties of Pipe—Computational Relations

$d = D-2t$	$\omega = 3.4\ A$
$A' = D\ \pi/12$	$\omega' = 0.433\ \bar{A}$
$A'' = d\ \pi/12$	$r = \sqrt{I/A}$
$A = (D^2-d^2)\pi/4$	$I = .0491\ (D^4-d^4)$
$A = d^2\ \pi/4$	$z = 2\ I/D$

TABLE 2—Design Properties of Pipe Output Data Format

	Word 1	Word 2	Word 3	Word 4	Word 5
Line 1	D	t	d		
Line 2	A'	A''	A	$\bar{A}$	
Line 3	ω	ω'	r	I	z

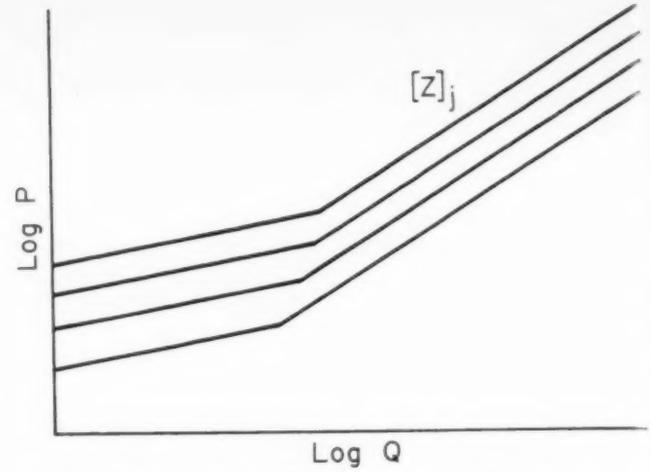


FIGURE 13—Typical schematic of a family of pressure drop curves for one line diameter plotted from computed data. For each line diameter considered here there will be a family of 23 viscosity curves labeled $[Z]_j$ in the figures.

put values will span the practical throughput range for each diameter.

Input data will include (a) the required set of viscosity values and (b) individual data sets containing internal diameter and minimum and maximum throughput for each given diameter. The program will divide the throughput range in each case into ten intervals and compute pressure drops at each interval. The program will generate approximately 13,800 pressure drop values.

The notation required follows:

D_k = Inside diameter, in.
z_j = Viscosity, cs.
Q_i = Throughput, b/d
P = Pressure drop, psi/mi.
R* = Modified Reynolds number.
Re = Reynolds number
f' = Friction factor—turbulent flow
f'' = Friction factor—laminar flow
s = Crude specific gravity
Q_1 = Minimum throughput, b/d
Q_{11} = Maximum throughput, b/d

Setting Up the Problem. The intended appearance of the plotted data for one diameter value is shown in Figure 13. For each line diameter size, there will be a family of 23 viscosity curves labelled $[z]_j$ in the figure. The break in the plotted lines occurs at the transition from laminar to turbulent flow. A minimum and maximum throughput value associated with each line diameter will be read as input. The program will be expected to divide this throughput range into ten intervals and compute the proper pressure drop value for each interval, for each viscosity value. The necessary computation relationships are shown in Table 3 along with the variable range and upper limits on D_k, z_j, and Q_i.

Flowchart for Pressure Drop Problem. The program starts with a read instruction for the entire family of viscosity values, $[z]_j$. Selection of the first diameter value is indicated by the initialization, k = 1. A return point is anticipated following the initialization and a fixed connector is installed.

This program is visualized as based on successive read operations, in each of which values for the minimum and

maximum throughput values associated with an individual line diameter will be read. The minimum and maximum throughput values are given the designation Q_1 and Q_{11} respectively.

Following the read operation, ΔQ is computed representing 1/10th the interval between Q_1 and Q_{11}. The selection of the first viscosity value is indicated by the initialization, $j = 1$. A return point is anticipated and provided. Identification of the final piece of data required for computation is given in the initialization, $i = 1$. A third return point is provided and the program is then completely initialized and prepared for computation.

Calculation of pressure drop is dependent upon laminar or turbulent flow conditions and this is determined by the value of a computed Reynolds number. Therefore, the modified Reynolds number R* and Reynolds number Re

TABLE 3—Computational Relationships for Pressure Drop Data Book Generation

D_k	$k = 1\ (1)\ m$	
z_j	$j = 1\ (1)\ n$	
Q_i	$i = 1\ (1)\ 11$	
	$R^* = .0119\ Q_i/D_k z_j$	
	$P = .241\ fsQ_i^2/D_k^5$	$s = 1.0$
	$f' = .00207\ (1/R^*)$	$Re < 1000$
	$f'' = .0018 + .00662\ (1/R^*)\ .355$	$Re \geq 1000$
	$\Delta Q = (Q_{11} - Q_1)/10$	$Re = 7742\ R^*$
	$Q_{i+1} = Q_i + \Delta Q$	

are computed and followed by a test to determine whether Re is greater or less than 1000.

Depending upon the result of this test, either a laminar or turbulent friction factor will be computed using the appropriate function given in Table 3. Following the friction factor calculation, pressure drop P is computed and the desired output is written containing D_k, z_j, Q_i and P. This write contains all data required for plotting purposes.

Problem specifications called for ten intervals, corresponding to 11 values of throughput. Therefore, i is tested against 11 to determine whether another value of i is required (with return to fixed connector 1) or whether the program may proceed to another viscosity value. The modification $i + 1$ becomes i will be interpreted by the programmer as calling for the computation of $Q_i + 1 = Q_i + \Delta Q$.

Following the test for completion of all throughput values, a test will be made, j against n, to determine completion of all viscosity values required. A third test, of identical structure with associated modification and loop, is provided for determination of completion of all line diameter cases.

The program is concluded upon completion of required computation and writing operations. Manual calculation of all data specified by this program would take well over one man year of time. Computer solution handles the calculation in less than one day.

More Complex Pipe Line Problems Can Be Handled, Too. These elements of a mathematical flowcharting system have been presented through elementary examples to permit clear comprehension. Problems represented relatively simple computational problems; the practical problems, too, may represent some of the simpler calculations pipe line engineers may wish to execute automatically by

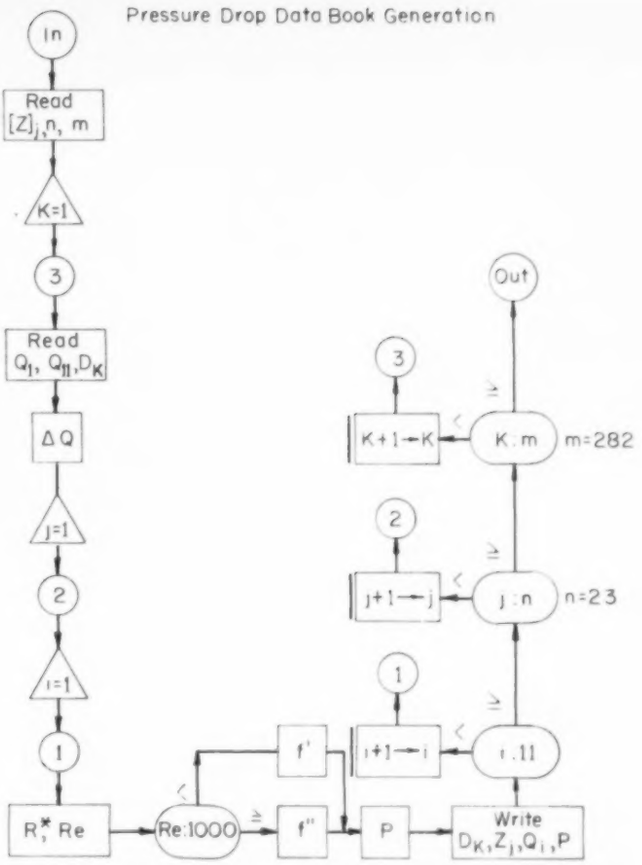


FIGURE 14—Flowchart for pressure drop data book calculations represents successive read operations in each of which values for minimum and maximum throughput are read for individual diameter. Minimum and maximum values are designated Q_1 and Q_{11}. Manual calculations of all the data specified here would take well over one man year; using a computer it would require less than a day.

stored program computers.

It is worth repeating that any engineer desiring to use the modern stored program computer effectively must make some effort to overcome the barrier between himself and the computing group which has arisen from the specialized language and notation used by the latter. An engineer making initial efforts in this direction will be met more than half way by the computing people. The flowchart represents one suitable avenue of study for extension of professional skill which should help in this direction. —**The End**

About the Author

T. R. Young, Shell Pipe Line Corporation, has been active in the exploitation of the electronic computer in the pipe line industry since 1955. Principal applications have been studied in both the technical and economic fields. He presented a summary of computer usage in pipe line economics at the ASME Petroleum Division Conference in Denver last year. Young is a 1943 graduate of the University of Michigan in chemical engineering. Following graduation he was employed as a research chemical engineer at the Beacon Research Laboratories of The Texas Company. Prior to joining Shell Pipe Line in 1952 he was associated with the University of Wichita Foundation for Industrial Research.

T. R. Young

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Engineering Design —60—Chart Reveals Tank's Vapor Formation Rate

When sizing the vapor piping for a manifolded expansion-roof tank system, the rate of vapor formation must be known. While the rate of vapor formation can be computed by longhand methods, the calculation is tedious and takes much valuable time.

Example: Determine the rate of formation of vapor in a 140,000 barrel capacity tank when it is filled at the rate of 8,000 barrels per hour.

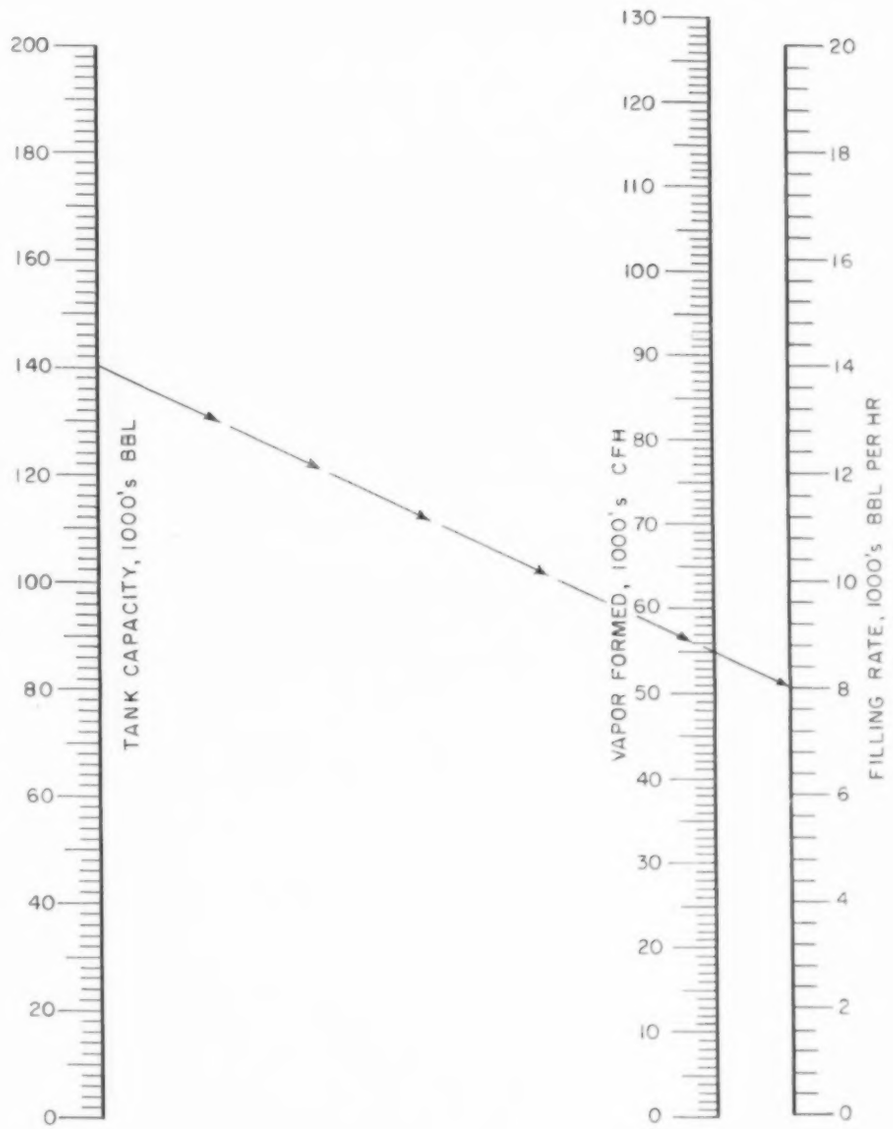
Solution: Enter the chart on the left at a capacity of 140,000 barrels and draw a straight line through the filling rate of 8,000 barrels per hour on the right. At the intersection with the central scale read the vapor formation rate as 55,000 cubic feet per hour. The vapor piping for this tank would have to be designed for this formation rate if the maximum filling rate anticipated were 8,000 barrels per hour. But if a greater filling rate was expected, the vapor formed would have to be computed for the higher rate. The chart could, of course, also be used for this computation.

This chart is based on the following equation:

$$V = \frac{\text{tank capacity, bbl.}}{14.3} + \frac{\text{filling rate, bbl. per hr.}}{0.178}$$

where V = vapor formed, cu. ft. per hr.

This idea was submitted by Steven D. George, International Engineering Associates, New York.



"On the road or off, our Ford tandem gets us there on time!"

says Mr. H. W. Stooksberry
Stooksberry Tank Co.
Lafayette, Louisiana

"We can't afford delays, and our new Ford T-700 provides the round-the-clock dependability we need.

"Our '59 Ford often runs 24 hours a day to meet the demanding schedules of this business. We haul six types of oil well testing equipment for both offshore and onshore work, and there's always a race against time on every job.

"This portable testing equipment is a big load, and one that pulls hard on the highway. At the wellhead, we often hit especially tough going. We stick with Fords for this work because our experience shows they do the best job, and do it fast and economically."

GO FORD-WARD for savings with '59 Ford Trucks!

Whatever your job . . . wherever you do it —you'll find Ford trucks are engineered and built to do it better! Whether you need a 4-wheel drive pickup like the one shown below—or a heavy-duty tandem similar to the one used by the Stooksberry Tank Co., you'll be *ahead* with a Ford. And for '59, there are even more reasons to invest in a Ford Heavy or Extra Heavy. You'll discover:

Greater operating economy with new, faster rear axle ratios and wider choice of transmissions.

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Factory installed tractor package custom-fitted to Ford trucks equipped with air brakes for more dependable and safer braking.

Yes, the new '59 Fords are here to take you *Ford*-ward for savings, *Ford*-ward for modern style and stamina. See your Ford Dealer today!

New Ford 4-wheel drive trucks available in ½- and ¾-ton pickup, stake and chassis-cab models. Ford-built at Ford's low prices. Available early 1959.

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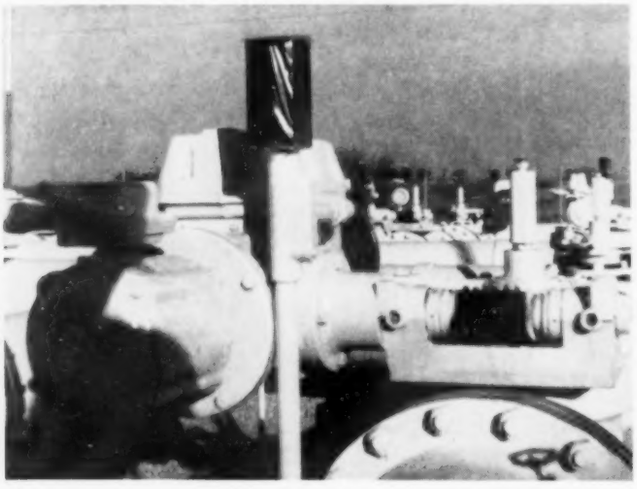
Every Ford has SAFETY GLASS in every window

How to do it

PIPE LINE HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1, Texas



Plastic Bags Protect Push Buttons From Ice

One pipe line company in the Mid-Continent area found that the use of plastic bags over pushbuttons in the manifold area of outside pump stations protect against ice accumulation.

The use of clear plastic allows operator to read the printing and actuate the button without removing the cover.

Make Portable Stand For Warning Sign Along R.O.W.

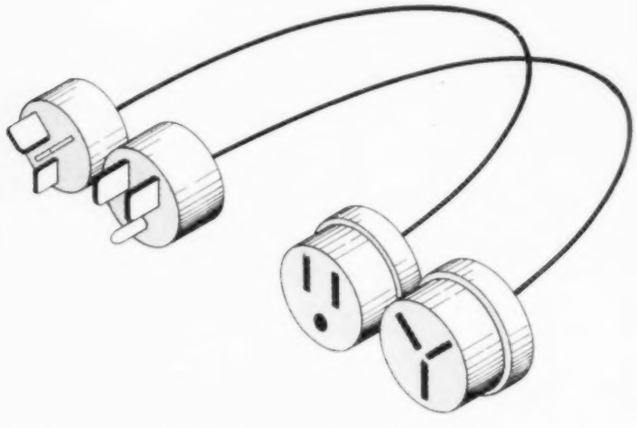
A portable stand for road warning signs to be used along the right of way can be frabricated from light angle iron. A standard caution sign and an electric red blinker light is attached to the stand which stands approximately 2 feet high.

The low cost, lightweight and sturdy unit can be carried along on spreads. With red light blinking both ways it is visible to traffic coming in either direction.

Use Metal Box to Protect Tractor Starting Controls

This homemade box fabricated from sheet metal slips over tractor starting and ignition controls and can be locked to safeguard the tractor when not in use.

This will discourage unauthorized persons from attempting to start and operate equipment if left overnight or week-ends on jobs.



Electrical Cheater Cords Insure Proper Grounding

Electrical "cheater" cords can be used for adapting a "grounded" power tool plug to various grounded receptacles. These cheaters can be made up and kept handy by the maintenance mechanic, electrician or carpenter.

They will insure proper grounding of all tools, regardless of the type receptacle encountered.

Fabricate Attachment For Cutting Metals on Band Saw

By fabricating a support for cutting metals on a band saw, the operator can cut the material more accurately and with greater safety.

The attachment consists of a piece of ⅛ by 4 by 18-inch channel iron with a ¾-inch slot $^{11}/_{16}$-inch deep milled about 3½ inches from one end. A piece of cold rolled steel ¾ by 1 by 8 inches was then placed into the slot flush with the front side and welded in place.

Next, placing the attachment on the band saw, it was pushed against the blade to mark the place where the blade would cut. The attachment was then removed and a ⅛-inch slot about 1 inch deep was milled about at this location. When it is necessary to cut several pieces, a small "C" clamp with a 1-inch long pad is clamped in place and located with a rule to use as a top. This can be put on and taken off when necessary.

Save Excessive Wear By Booming Tandem Front Wheels

When it is necessary to pull an empty pipe trailer on long hauls, excessive wear can be prevented by booming up the front wheels in the tandem, having only the back two wheels touching the road. This also stiffens the trailer assembly making it track better.

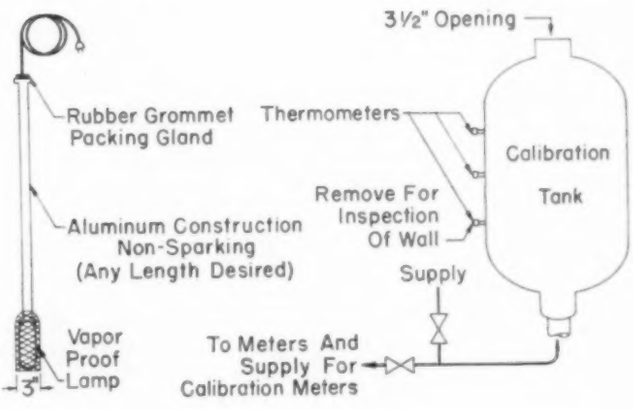
The chain is hooked around the front of the trailer just ahead of the wheels and through an eye welded in the front of the pipe bolster above the fifth wheel. When the chain is boomed up, the wheels are drawn up into the clear. This leaves the bound up assembly as one tight unit and free to turn on the fifth wheel on the back of the bobcat truck.

Vapor-Proof Lamps Safe For Examining Prover Tanks

An improved method for examining calibration tanks or build-up on walls and other purposes can be made with the use of a vapor-proof lamp small enough to fit through a 3½-inch opening.

The lamp can be used on 110 volts AC or 12 volts DC by changing lamps; it can be used in the field and at stations. The apparatus can be applied to check build-up in field tanks as well.

The vapor-proof light is a safety measure against any possible explosions which may occur with the use of an ordinary incandescent lamp.

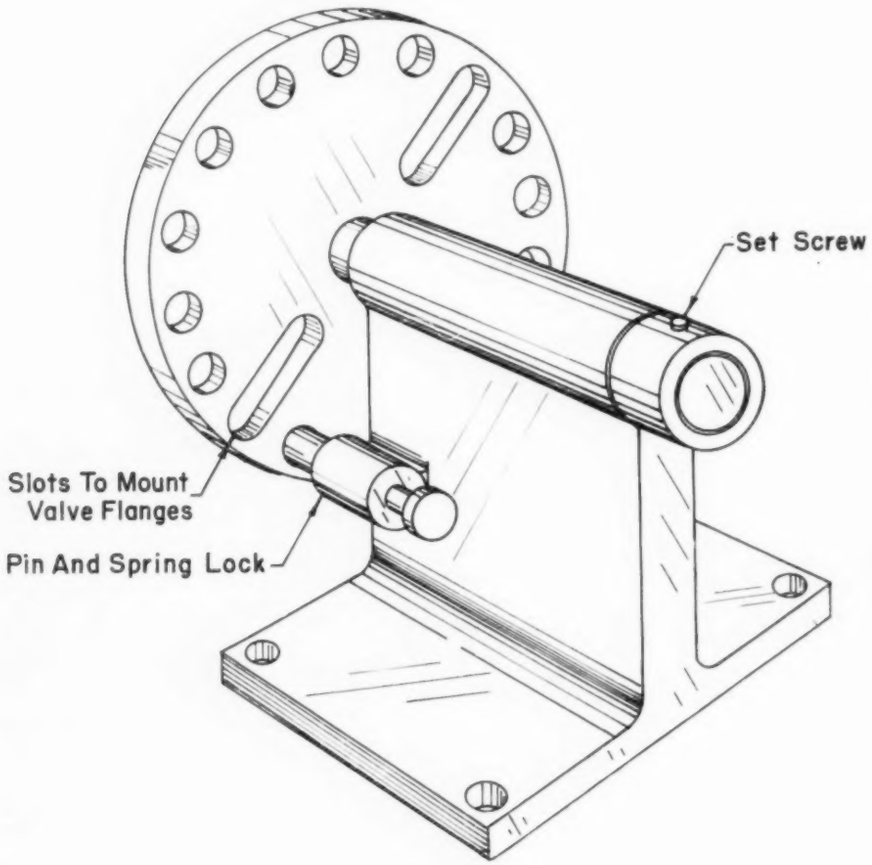


Slots in Jig Make Valve Servicing Easy

Valves are clumsy items to work with. When you set them on a work bench, they tip over very easily. Consequently, it usually takes one hand and your hip to hold a fairly large valve, while you work on it with the free hand.

A simple solution to this problem is to make the above pictured jig for holding flanged valves. The jig face can be made from one half inch steel plate, and of a diameter equal to the largest valve that you normally service in your shop. The valve flange bolt holes are lined up with the jig face slots and the two are connected with bolts and nuts. The assembly can be rotated 360 degrees, and is held in place by a pin and spring lock that snaps into one of the holes drilled in the jig face.

The jig should be bolted to the edge of a work table. Now, with both hands free, watch your valve maintenance costs drop.

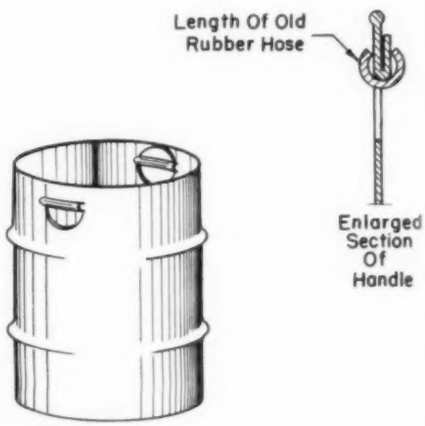


Convert Scrap Pipe, Metal Into Shopmade Gager's Box

If you need a container for holding run tickets or messages for the pumper or gager on your lease, this homemade mailbox might do the job.

Cut a piece of 6-inch pipe about 1 foot to 18 inches long and weld a plate over one end to form the back. Make a similar plate for the front, but instead of welding it in place, pivot it at the top on a bolt as shown in the illustration. By welding a small piece of ¼-inch rod on the front cover plate for a handle, the container is complete. The weight of the pivoted plate is enough to keep the container closed and the contents safe from the weather.

The container can then be mounted on a length of 2-inch pipe and supported or reinforced by a piece of sucker rod. To prevent rain from running into the container, it should be mounted with the front end slightly lower than the back end. This type of message box can be made very attractive and adds to the appearance of a lease.



Use Rubber Hose To Make Hand Holds on Trash Barrel

Safe, easily made hand holds for a trash or water barrel can be made out of a piece of old rubber hose. Cut a half-moon arc near top of the barrel, bend up and slip short length of old rubber hose over the bent up section.

Editorial Index Now Available

The Editorial Index is now at the printers and soon will be ready for distribution. The 1958 Editorial Index provides a time-saving entry into all 12 issues of PIPE LINE INDUSTRY published in 1958.

Bound in a handy pamphlet form for easy accessibility, the Editorial Index lists each and every article and its author. To get a copy, write Librarian, Gulf Publishing Company, P. O. Box 2608, Houston 1, Texas. Or, if you prefer, check the square provided on the blue Reader's Service Card at the back of this and every issue of PIPE LINE INDUSTRY.

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WHAT'S HAPPENING

IN PIPE LINE CONSTRUCTION

By Donald G. DePugh, Construction Editor

New York State Natural Gas Plans 57 Miles of 20-26-Inch

New York State Natural Gas Corporation plans to construct 57 miles of 20- and 26-inch gas lines and install additional horsepower at four compressor stations in its 1959 expansion program.

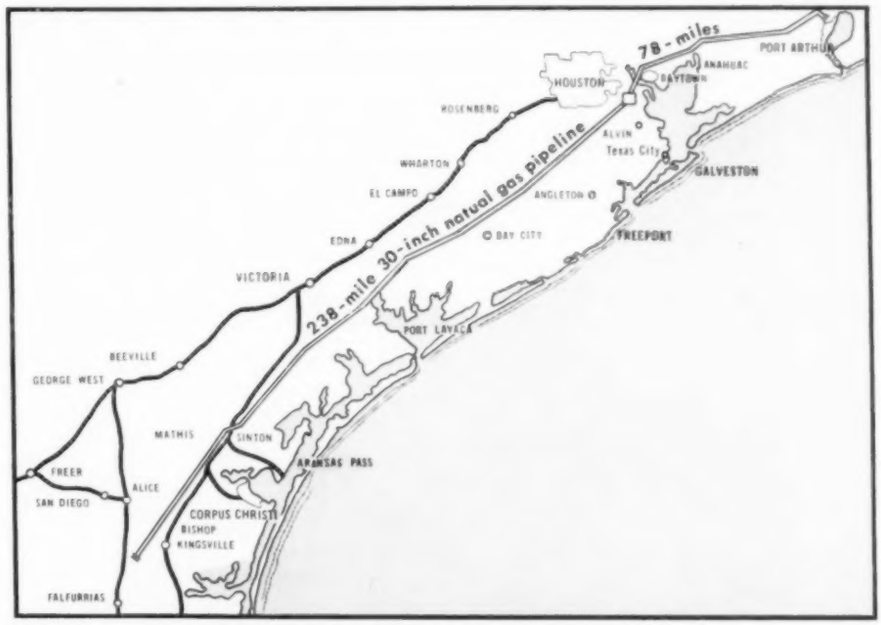
Projects include construction of 43 miles of 20-inch from a point west of Kittanning, to Luthersburg, Penn.; laying a 14-mile, 26-inch line from Little Marsh in Chatham Township, Penn., to the company's Boom compressor station near Lawrenceville, Penn.; and additional horsepower at Woodhull and Utica, N. Y., and Preston and Tonkin, Penn., stations.

Development work in the Woodhull storage pool in Steuben County, New York, will continue in 1959. When completed the underground storage reservoir will have a capacity of 35.2 billion cubic feet of gas.

Niagara Mohawk Awards Contracts on Two Lines

Niagara Mohawk Power Corporation has awarded a contract to Fulghum Contracting Corporation to construct a 100-mile, 12-inch gas line from Watertown to Messena, N. Y. Completion is expected by August.

Niagara also let contract on 26 miles of 12-inch to Consolidated Gas & Service Company. The line will extend from Volney to Ellisburg, N. Y., and would be completed by May.



Route of Humble's line from Clear Lake to Kingsville. 78-mile section line from Clear Lake to Port Arthur has been completed.

Humble Lets Contract to Panama, Inc. On 238-Mile, 30-Inch Gas Pipe Line

Humble Oil & Refining Company has awarded a contract to Panama Inc. to construct a 238-mile, 30-inch gas pipe line from the future site of Humble's King Ranch plant to Clear Lake near Houston.

The line will tie in with the recently completed 78-mile, 24- and 30-inch line extending from Clear Lake to Port Arthur. Work started on the main line in late January and should be completed by 1960. Part of a $75 million Humble expansion program, the line will not have any compressor stations between King Ranch and Clear Lake.

Humble has completed over 84 miles of its 200 miles of gathering lines planned for the King Ranch area.

With completion of the new line, Humble will be able to serve industrial areas all along the Gulf Coast.

PG&E, Pacific Gas Transmission Co. Request Permission To Build Gas Line

Pacific Gas Transmission Company, a newly formed subsidiary of Pacific Gas & Electric, filed an application with the Federal Power Commission seeking permission to construct the 614-mile section of a 1,300-mile system, 36-inch gas line from the Canadian border to San Francisco Bay area.

Pacific Gas & Electric has requested authorization from the California Public Utilities Commission to construct the 296-mile portion in California.

The $333 million line would transport 420 MMcf of gas daily from Alberta to California markets. Pacific Gas Transmission Company would own and operate the section extending from Kingsgate, B.C., through Idaho, Washington and Oregon and PG&E would carry gas through northern California to its terminal near Antioch.

PG&E plans to construct a third loop on its system to receive gas from Texas and New Mexico area. A 49-mile, 34-inch loop and an additional 13,500 horsepower will be installed on the system.

Coastal Awards Final Contracts on Gas Line

Coastal Transmission Corporation has awarded final contracts on its 575-mile gas line from McAllen, Texas, to Baton Rouge, La.

Sharman, Allen, Gay and Taylor will construct 63 miles of 22-inch between Bay City and Galveston Bay, and Barry Construction Company will lay 63 miles of 3- and 8-inch gathering lines in Gulf Coast.

Coastal plans to complete construction of its system, which is part of the Texas-to-Florida line, before summer 1959.

Canadian PLCA to Hold Fifth Annual Convention at Bermuda, February 25-28

The Pipe Line Contractors Association of Canada, after completing "one of the best" years for Canadian pipe liners, will hold its annual convention in Bermuda February 25-28 at the Castle Harbor Hotel.

Highlights of the convention will include the president's report, by President C. A. Callahan, vice president of Majestic Contractors Ltd.; presentation of the revised editions of the association's Safety Manual and Equipment Rental Manual and a report of Labor Committee.

A welcome address will be given by Hon. H. A. Butterfield, C.B.E. member of Bermuda Legislative Council. R. A. Brown, Jr., president of Home Oil Company Limited, and Wm. J. Klein, vice president of Allis-Chalmers Manufacturing Company will address the association at the general session February 28.

Executive officers of the association are President Callahan, Gordon Walker, Mannix Co. Ltd., first vice president; E. A. Hooper, F. E. Shaw Ltd., second vice president, and G. A. Wilkinson, Marwell Construction Co. Ltd., treasurer.

Directors of the association include R. K. Banister, president of Fulton-Banister Ltd.; Robert Thomas, River Construction Corporation, and D. J. Baldwin, Marine Pipeline & Dredging Ltd. A. O. Ackroyd is executive secretary.

1959 CONVENTION PROGRAM

Wednesday Afternoon—Feb. 25
Meeting of the Board of Directors
President's Report—C. A. Callahan
Annual Report of Executive Secretary—A. O. Ackroyd

Wednesday Evening—Feb. 25
Koering-Waterous Ltd.—Reception

Thursday Morning—Feb. 26—10 a.m.
President's Call to Order and Address of Welcome
Hon. H. A. Butterfield, C.B.E., 'Welcome to Bermuda'
President's Report to Members

Thursday Noon—Feb. 26
Cessco—(Canadian Equipment Sales & Service Co.)
Luncheon and Reception

Thursday Afternoon—Feb. 26
Business Meeting of Regular Members
Chairman-Pres. C. A. Callahan
Presentation of Second Editions—
Safety Manual
Equipment Rental Manual
Report of Labor Committee—Chairman G. A. Wilkinson

Thursday Evening—Feb. 26—6:30 p.m.
Crose-Curran Ltd.—Reception and Dinner

Friday Morning—Feb. 27—10 a.m.
Golf Tournament—Open to all Members

Friday Noon—Feb. 27
Yacht Cruise for the Ladies—Allis-Chalmers Manufacturing Company. Luncheon and Entertainment.

Friday Evening—Feb. 27—6:30 p.m.
Caterpillar Americas Co. and Canadian Caterpillar Dealers Present—Reception and Dinner

Saturday Morning—Feb. 28—10 a.m.
General Meeting all Association Members, Chairman-Pres. C. A. Callahan
Guest Speaker—R. A. Brown Jr. of Calgary, President Home Oil Company Limited
Guest Speaker—Wm. J. Klein of Milwaukee, Vice President, Allis-Chalmers Manufacturing Company

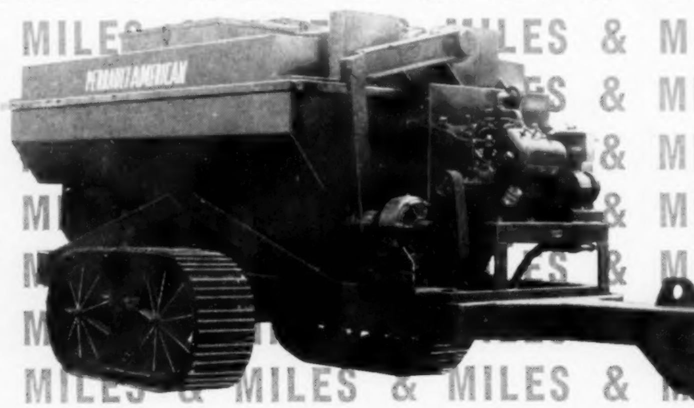
Saturday Noon—Feb. 28
To Be Announced at Convention

Saturday Afternoon—Feb. 28
Business Meeting of Members
Chairman—C. A. Callahan
Nominating Committee Report
Election of Officers and Directors

Saturday Afternoon—Feb. 28—4:30 p.m.
Elected Executives—Initial Meeting

Saturday Evening—Feb. 28—6:30 p.m.
Annual Banquet and Reception
Courtesy Pipe Line Contractors' Association of Canada

PROVED BY MILES & MILES & MILES & MILES & MILES & MILES & MILES & MILES & MILES & MILES & MILES & MILES & MILES & MILES & MILES & MILES



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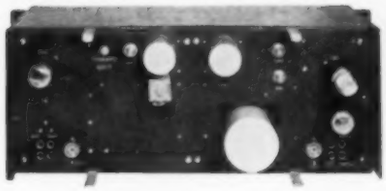
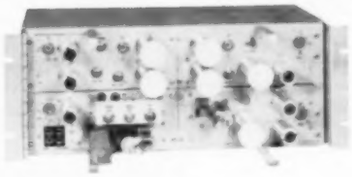
Telegraph Carrier: stackable and compact; simple to install and maintain; provides electronic keying, flexibility of system arrangement, two- and four-wire operation, loop options, easy access to components. **Ask for Bulletin T-2001.**





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Heated Crude-Products Line Considered by Italian Firm

Societa Nazionale Metanodotti is considering building a 225-mile, 18-inch heated pipe line to carry crude oil and heavy fuel oil from Genoa to Milan-Cremona-Torino, Italy.

The line would also extend through the Alps into Switzerland to deliver crude to refineries near Lake Geneva. SNAM plans to batch the crude and product, if possible, or to build two lines. Fuel oil would be delivered to industrial areas of Milan and Torino and crude would go to Cremona and Switzerland.

Pump stations are planned at Genoa, Pavia and three stations will be installed between Torino and Geneva. The line would be tunneled through the Alps at an altitude of 6,000 feet.

The fuel to be transported is of about the same grade as number 6 fuel oil.

North Carolina Natural Gas Lets Contract to H. L. Gentry

H. L. Gentry has been awarded a contract by North Carolina Natural Gas Corporation to construct over 163 miles of 6- through 12-inch pipe line in its intrastate gas system.

North Carolina earlier let contracts on nearly 400 miles of the 600-mile system to J. P. Neill Company, C. N. Flagg & Company and Somerville Construction Company.

Midwestern, Tennessee Hearing Set for Feb. 16

Hearing on companion applications of Tennessee Gas Transmission Company and Midwestern Gas Transmission Company will resume February 16.

Midwestern proposes to build a 350-mile, 30-inch gas line from Portland, Tenn., to Joliet, Ill., to supply gas to the Chicago-Gary area. Tennessee, parent company of Midwestern, plans to lay 157 miles of 36-inch loop lines in Louisiana and Mississippi and install an additional 114,900 horsepower in existing compressor stations in Texas, Louisiana, Mississippi and Tennessee to furnish gas to Midwestern.

Hearings began December 17 and recessed on December 19.

LADISH

Controlled Quality

LIGHT WEIGHT
WELDING NECK
FORGED FLANGES
125 POUND

TO MARK PROGRESS

Reduce cost... eliminate breakage of cast flanged-end piping components when bolting to steel welding neck flanges

PIPING PROBLEM:

(1) Difficulty experienced in making pressure tight connection with flat face flanges with full face gaskets.

(2) Breakage of relatively brittle cast iron flanged ends on valves, pumps and other piping components when bolted to standard 1/16" raised face steel flanges.

LADISH SOLUTION:

The 125 pound Light Weight flange developed by Ladish is an ideal solution to this problem . . . for not only does it solve the problem . . . but it provides significant additional advantages of cutting purchase costs and reducing weight.

You can depend on Ladish for leadership in introducing piping developments to reduce cost and improve service.

A national network of distributors, Ladish plants and sales offices is ready to serve you.

Specification sheets on Light Weight Flanges and Welding Fittings available on request.

POSITIVE, LEAK-TIGHT JOINTS

Proven design principle of raised face flange has been adapted to assure a completely safe, positive connection to class 125 cast iron flat face flanges.

ELIMINATES NEED FOR HEAVY FLANGED ENDS ON VALVES AND PUMPS

No longer is it necessary to pay a premium to obtain the heavier flanged end valves, pumps and other piping components required to withstand bolting to raised face steel flanges in a welded piping system.

LOW WEIGHT—AMPLE STRENGTH

Light cross section design reduces weight to 30-50 per cent of ASA 150 pound Welding Neck Flange . . . still possesses ample strength to assure safe, leak-tight joint with mating cast flange.

LOWER COST

Savings in purchase price of Light Weight flanges are supplemented by additional savings realized by selecting valves on the basis of pressure rather than strength characteristic of flanged ends.

EASE OF INSTALLATION

Adequate welding neck type hub length keeps welding heats safely from flange. Prevents unpredictable warpage and deformation. Light weight facilitates handling, speeds positioning and installation.

MINIMIZES PIPEFITTER PRECAUTIONS

Safe and suitable for use with either carbon or alloy steel bolting . . . either full face or ring gaskets, in 1/16" or 1/8" thicknesses.

PRESSURE-TEMPERATURE RATING

Rating corresponds to ASA B16.1 class 125 cast iron flanges . . . 125 PSI (gauge) saturated steam; 175 PSI (gauge) water, oil or gas at 150° F.

SERVICE APPLICATIONS

Widely accepted for low pressure piping in gas distribution service . . . utility services such as water, heating, air conditioning, refrigeration . . . pumps and compressors.

TO MARK PROGRESS

LADISH CO.

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LADISH...THE FITTINGS LINE THAT OFFERS COMPLETE SERVICE IN TYPES, SIZES AND MATERIAL SPECIFICATIONS

WELDING FITTINGS	ASA & MSS FLANGES	SCREWED & SOCKET FITTINGS & UNIONS	LONG NECKS	LARGE DIAMETER & T.E.M.A. FLANGES

WHY PIPELINERS DEPEND ON GORMAN-RUPP PUMPS

How do you lay a pipeline? You dig the dirt. You blast the rock. You fight the water. And you try to stay on schedule.

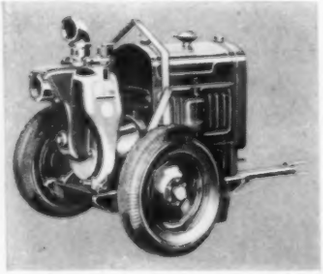
When it rains hard . . . or you hit a bog, that water can lick you. So you depend on Gorman-Rupp Pumps.

Laying pipelines, the pumping jobs come up in a hurry, require fast pumping. You dare not fail—so you call on Gorman-Rupp Pumps. They keep the job moving . . . whether for highways, dams, bridges, buildings . . . or for pipelines.

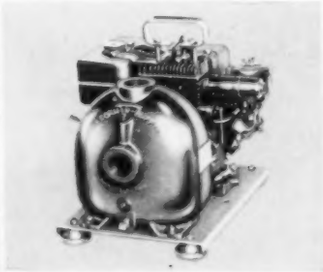
Pipeliners *know* Gorman-Rupp Pumps are "unsurpassed for pumping fast." You are near a Gorman-Rupp Distributor. In emergencies, telephone.

THE GORMAN-RUPP COMPANY

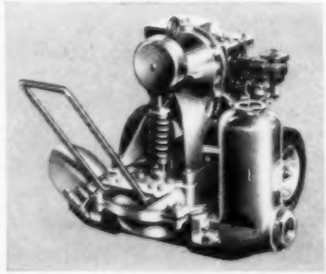
305 Bowman Street • Mansfield, Ohio



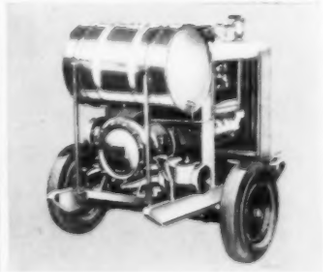
Contractors' Pumps — 3" to 10"



"80" Series Lightweights — 1½" to 3"



Diaphragm Pumps — 3" and 4"



Jetting Pumps

Michigan Wisconsin Granted FPC Temporary Approval

Michigan Wisconsin Pipe Line Company has been granted temporary Federal Power Commission authorization to construct 353 miles of 14-inch gas lines and 16,560 additional horsepower.

The proposed facilities, to cost $31 million, will be built in Kansas, Missouri, Iowa, Illinois and Michigan.

Commissioner Connole Elected Vice Chairman

Commissioner William R. Connole has been elected by The Federal Power Commission to serve as its vice chairman for 1959. A member of the commission since 1955, Connole succeeds Frederick Stueck, who served as vice chairman the past two years.

Buckeye Pipe Line Company Plans 70-Mile Products Line

Buckeye Pipe Line Company announces plans to construct a 70-mile, 8-inch products line from Wayne to Flint, Mich.

The $3 million project will be completed in the summer.

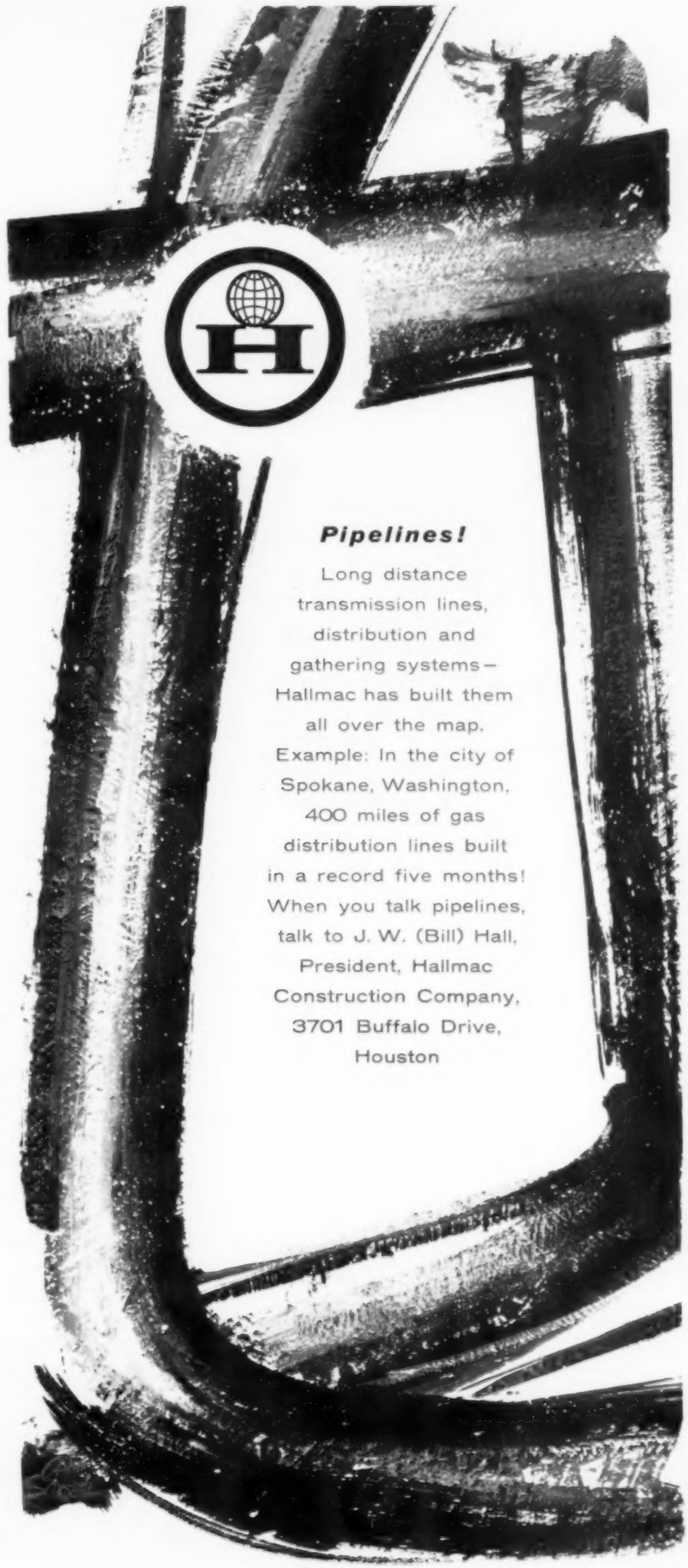
NACE Short Course At Tulsa Feb. 11-13

The tenth annual short course for pipeliners sponsored by Tulsa section, NACE, will be held February 11-13. The three-day course, covering practical control of pipe line corrosion, is planned for pipe line foremen, superintendents, field engineers and inspectors.

Engineers who will conduct lectures and discussions include J. P. Barrett, Pan American Petroleum Corp.; J. N. Hunter, Jr., Service Pipe Line Company; O. W. Everett, Oklahoma Natural Gas Company; J. R. Cowles, Agra Instrument Co.; T. L. Canfield, Cathodic Protection Service; Y. W. Titterington, Corrosion Services, Inc.; W. A. Hutchinson, Sinclair Pipe Line Company; L. G. Sharpe, Texas Eastern Transmission Corporation; W. E. Huddleston, Huddleston Engineering Co., and G. J. Paisley, Socony Mobil Oil Co.

Hearing on Transwestern Application Resumes April 13

The Federal Power Commission has ordered the hearing on an application by Transwestern Pipeline Company to resume on April 13.


H
Pipelines!
Long distance transmission lines, distribution and gathering systems—Hallmac has built them all over the map. Example: In the city of Spokane, Washington, 400 miles of gas distribution lines built in a record five months! When you talk pipelines, talk to J. W. (Bill) Hall, President, Hallmac Construction Company, 3701 Buffalo Drive, Houston

PROPOSED PIPE LINE CONSTRUCTION

Here in convenient summary form is Pipe Line Industry's listing of company, line size, length, service, location and project status.

U. S.

Buckeye Pipe Line Company, New York, 70 miles, 8-inch, products, from Wayne to Flint, Michigan, planned.

Arkansas Industrial Pipeline Corp., Shreveport, 130 miles, 18-inch, gas, Perla-to-Helena, Ark., $9 million, planned.

Arkansas Louisiana Gas Co., Shreveport, 100 miles, 16-inch, gas, from near Clarksville-to-Jones Mill, between Malvern and Hot Springs, Ark., $6 million, planned.

American Louisiana Pipe Line Co., Detroit, two 12,000 hp compressor stations in Ohio and Indiana; additional 2,000 hp at existing stations in Mississippi and Tennessee; 3 miles pipe line, meter station in Cameron, La., $7 million, FPC authorization.

Chicago District Pipeline Company, 52 miles, 30-36 inch, gas, from Natural Gas' proposed line at Joliet to Chicago, $13 million, before FPC.

Cities Service Gas Company, Oklahoma City, 106 miles, gas, gathering, in Montgomery, Allen, Franklin, Miami, Johnson, and Wilson counties, Kansas, 3,600 hp to Blackwell station, Kay County, Kansas, FPC authorization.

Coastal States Gas Producing Co., Corpus Christi, Texas, 289 miles, 14 and 18-inch main line and gathering system, McAllen to Falfurrias, Tex., area, and Lopena to La Salle County, $12 million, planned.

Coastal Transmission Corp., Houston, 574 miles, 22-24 inch, gas, from McAllen, Texas to Baton Rouge, La. connection of Houston, Texas Gas and Oil plus 414 miles of laterals, $55 million, contracts let on compressor stations to Gasoline Plant Construction Corp. Contract let miles, main and laterals, to Oklahoma Contracting Co., and O. R. Burden Construction Corp., River Construction Corporation, Parson Company, Brown & Root, Buddy Sherrod, Inc. and Sharman, Allen, Gay & Taylor.

Colorado Interstate Gas Co., Colorado Springs, 140 miles, gas, Green River, Wyo.-to-Provo, Utah; 109 miles, 26-inch, Texas Panhandle to southeastern Colorado; 136 miles, 34-inch, southeastern Colorado-to-Pueblo, Colo.; 107 miles, 30-inch, Pueblo-to-Denver, $91 million, before FPC.

Conn-Mass Pipe Line, Inc., Orange, Conn., 88 miles, 8 inch, products, from Boston to Springfield, Mass., considered.

133 miles, 16-inch, products, from Linden, N. J. to Hartford, Conn., considered.

62.2 miles, 8-inch, products, from New Haven, Conn. to Springfield, Mass., considered.

38 miles, 6-inch, products, from Waltham, Mass. to Fitchburg, Mass., considered.

Consumers Power Co., 45 miles, gas, main line, from Woodbury station to Laingsburg Junction, Mich., planned.

126-miles, 26-inch, gas, main, Michigan-Indiana border to Plymouth, Mich., planned.

El Paso Natural Gas Company, El Paso, 216 miles, 26 to 34-inch main line, 533 miles, 6-20-inch laterals, gas, 86,750 compressor hp; 126 miles, 30-inch main line, 266 miles, laterals, gas, 28,920 compressor hp in new and existing stations in Arizona, New Mexico and Texas, contracts let on 819 miles to R. H. Fulton & Co., McVean & Barlow, Inc., Western Pipe Line, Inc., Eastern Pipeline Contractors, and Engineers Limited Pipeline Co.

400 miles, 34-inch, Salt Lake City, Utah, to California border, planned.

Equitable Gas Company, Pittsburgh, Penn., 11.7 miles of storage pipe line and other facilities, $2,091,430, authorized.

Everglades Pipe Line Company, Miami, Fla., 35 miles, 10-inch, products, Port Everglades to Miami International Airport, $2.5 million, planned.

Gillette Pipeline Co., Cheyenne, Wyo., 103 miles, crude, from Dead Horse Creek field to Casper, Wyo., planned.

Great Northern Railway, St. Paul, 400-600 miles, 12-20 inch, crude, from Williston Basin to St. Paul-Minneapolis and Duluth-Superior areas, considered.

Gulf Interstate Gas Co., Houston, 12.8 miles, 6 and 20 inch, gas, loop line in Louisiana, $730,000, authorized.

Gulf Pacific Pipe Line Company, 1,600 miles, 30-inch, gas, Louisiana to California border, considered.

Gulf Resources, New York, 125 miles, gas, gathering system, from Lopena area in Zapata County to a point in La Salle County, Texas, planned.

Humble Oil & Refining Co., 238 miles, 26 or 30 inch, gas and 116 miles, main gathering system, varying sizes, from southwest Texas to Houston, plus gas processing and cycling plant near Corpus Christi, $75 million contract let on 238-mile, 30-inch main line to Panama, Inc.

Iron Ranges Natural Gas Co., 115 miles, gas, from Itasca and St. Louis counties along route of Mesabi range from Grand Rapids to Aurora, Minn., $5 million, before FPC.

Katy and New York Central Railroads, 2500-mile, 10-12 inch, LPG, from Houston, Texas, to New York, considered.

Manufacturers Light and Heat Co., Pittsburgh, Penn., 21-miles, gas facilities in Pennsylvania and West Virginia, $1 million authorized.

34-miles, 20-inch, in Greene, Adams, and York counties, Penn., authorized.

Michigan Gas Storage Co., Jackson, Mich., gas, facilities in central Michigan, $2 million, authorized.

Michigan Wisconsin Pipe Line Co., Detroit, 621 miles, gas, 14,280 additional hp, $32 million, appeal temporary FPC authorization on 353 miles.

20.5 miles, 24-inch, main line loop in Michigan, before FPC.

Midwestern Gas Transmission Co., Houston, 350 miles, 30-inch, gas, Portland, Tenn. to Joliet, Ill., $50.8 million, before FPC.

Mookl Chemical & Gas Corp., Tulsa, and Missouri Transmission Corp., Springfield, Mo., 425 miles, 16-inch, gas, from Oklahoma City area to St. Louis, before FPC.

New York State Natural Gas Co., Pittsburgh, 30 miles, 20-inch, gas, main, Silver Springs to East Elma, N. Y., $1.6 million, temporary FPC authorization.

43 miles, 20-inch, point west of Kittanning to Luthersburg, Penn, 14 miles, 26-inch, Little Marsh in Chatham Township to Boom station near Lawrenceville, Penn., and additional horsepower at Woodhull, Utica, N. Y., and Preston and Tonkin, Penn., planned.

Niagara Mohawk Power Corp., Syracuse N. Y., 100 miles, 12-inch, gas, Watertown to Messena, N. Y., contracts let to Fulghum Contracting Corp.

26 miles, 12-inch, gas, Volney to Ellisburg, N. Y., contract let to Consolidated Gas & Service Co.

North Carolina Natural Gas Corp., 630 miles, 2-16 inch, from Transco's system near Mooresville across to southeastern North Carolina, $30 million contracts let to C. N. Flagg & Company, J. P. Neill Co., Somerville Construction Company and H. L. Gentry Construction Corp.

Northern Illinois Gas Company, 140 miles, 24-inch, gas, main line, East Dubuque to Des Plaines, Ill., planned.

Northern Natural Gas Co., Omaha, 167 miles, 20 inch, gas, from Farmington, Minn. to Duluth, Minn., and Superior, Wis., $12 million, before FPC.

42 miles, 10 inch, gas, from Rochester, Minn. to Winona and Goodview, Minn., $963,000, before FPC.

365 miles, gas, new facilities in Minn., Iowa, S. D., Neb., Wis., plus 1090 miles of branch line and station facilities, $65.7 million, authorization for a part. Gas facilities in Texas, Oklahoma and Kansas, $6 million, before FPC.

454 miles, main line loops and extensions, 6-30-inch, main line from St. Cloud, Minn., to Grand Forks, N. Dak., also 1,490 miles of branch lines, 2-10-inch, and station additions totaling 32,000 horsepower, $86 million, planned.

27.6 miles, 30-inch, gas, loop; 18.3 miles north of Beaver station in Okla., 9.3 miles north of Sunray station in Texas, $3 million, authorized.

Northern Utilities Co., 35 miles, 16 inch, gas, in Fremont Natrona County, Wyo., area; 8 miles, 12 inch, around Casper; 6 miles, 8 inch, from Sand Draw gas field to Beaver Creek field; 12 miles, 6 inch, from Beaver Creek field to the system servicing the Riverton-Lander area, planned.

Ohio Fuel Gas Co., 51 miles, gas, main lines, in Belmont, Carroll, Cuyahoga, Fairfield, Logan, Lorain, Marion, Mus-

Kingun, Stark and Wayne counties, Ohio, $2.2 million, authorized.

Natural gas storage field in Medina County, Ohio, 12 miles, 4½ to 20-inch gas, $5 million, authorized.

Pacific Gas & Electric Co., San Francisco, 296 miles, 36-inch, gas, from Klamath Falls, Ore., to Antioch, Calif., southern section of line from Canada to California, before California Public Utilities Commission.

Pacific Gas Transmission Co., San Francisco, 614 miles, 36-inch, Kingsgate B.C. to Klamath, Ore., northern section of Canada to California line, before FPC.

Pacific Lighting Gas Supply Co., 128-mile, 34-inch, gas, main line from Topock, Ariz. to Newberry, Calif., authorized.

Pacific Northwest Pipeline Corp., Salt Lake City, 235 miles gas, gathering lines in San Juan Basin, Garmesa, Piceance Creek, and Big Piney Fields, $13.5 million, planned.

65 miles, gas, sales laterals in Washington, $1.5 million, planned.

Pennsylvania Gas Co., Warren, Penn., 38 miles, 8 and 10 inch, gas, in Erie and Warren Counties, Penn., and Chautauqua County, N. Y., $2.6 million, authorized.

Piedmont Gas Co., Hickory, N. C., 78 miles, 2-8 inch, gas, from connection with Transcontinental Gas Pipe Line to serve customers in North Carolina, $2.6 million, authorized.

Pioneer Natural Gas Co., Amarillo, Texas, 62 miles, 10-inch main, Pampa, Texas, to Canyon, in Randall County, Texas, 20 miles, small diameter, gathering, 4,000 h.p. stations, $4.5 million, planned.

Phillips Petroleum Co., 25 miles, 6 to 20-inch, gas, South Eunice, New Mexico area, planned.

52 miles, 4 to 20-inch, gas, Gaines County, Texas, planned.

44-mile, 6-inch, products line, from Rocky pump stations to Amarillo, Texas, planned.

Service Pipe Line Company, Casper, Wyo., 4,000 compressor hp at Herndon, Kans., 2,000 compressor hp at Scranton, Kans., and 2,000 compressor hp at LaGrange, Wyo.; additional 2,000 hp at Laton station, Rocks County, Kans., 2,200 additional hp at Elk Basin, Kirby, Owl Creek, and Lost Cabin stations, north of Casper, Wyo., planned.

Southern California and Southern Counties Gas Cos., Los Angeles, 200 miles, 34-inch, from Nevada-California border to point near Fullerton, Calif., $44 million, before Public Utilities Commission.

Southern Kansas Pipe Line Co., Inc., Arkansas City, Kansas, 200 miles, 6-10 inch, crude, southwestern Kansas to Arkansas City, Kansas, planned.

Southern Natural Gas Company, Birmingham, 136 miles, 24 and 26 inch; 215 miles, various diameter supply lines; 3,650 additional compressor horsepower to White Castle and Toca Stations; 8 miles, contract let to Conner Construction Co., 20-inch loops; 660 hp Franklinton station, and 23 measuring stations. $40 million, contracts let to William Brothers, Western Pipe Line, Inc., Brown & Root, Inc., and River Construction Corp. on 305 miles.

458 miles, 16-24-inch, loop lines, gas, between Gwinville, Miss., and Wrens, Ga.; 62 miles, 14-inch, loops, along Atlanta-Macon line; 53 miles, 6⅝ to 14-inch, loops, along various branch lines. 3,140 additional hp at Gallion and Elmore, Ala. and Wrens, Ga. 60 miles, 20-inch, loops, in Louisiana between Franklinton and White Castle and South of Toca. Lateral lines south of Gwinville and west to Cranfield field, 8,720 hp added at Franklinton, White Castle, Patterson and Brookhaven. $65 million, contracts let to River Construction Corp., H. C. Price, Latex Construction Co., and Houston Contracting Co. on 355 miles.

Tennessee Gas Transmission Co., Houston, 264 miles loop lines in Tennessee, Kentucky, West Virginia and Pennsylvania, FPC Examiner authorization.

Compressor stations in Mississippi, Tennessee, New York, Pennsylvania and additions in Tennessee, Kentucky, Ohio and Pennsylvania, $129 million, FPC Examiner authorization.

21 miles, 16-inch, 2 miles, 12¾-inch, gas, Louisiana coast, Vermillion, Blocks 46 and 64, $2.9 million, before FPC. 158 miles, 36-inch, looping system in Louisiana and Mississippi, to supply Midwestern additional gas at Portland, Tenn. $61.4 million, before FPC.

Texas Eastern-Penn-Jersey Transmission Corp., Shreveport, La., 65 miles, gas, from Delmont, Penn., to Lambertville, N. J., before FPC.

24,000 compressor hp additions to existing stations, $4.4 million, temporary FPC authorization.

4,000 horsepower to its Delmont, Penn., compressor station, five new compressor stations in Pennsylvania with total capacity of 67,000 hp, $11.2 million, authorized.

Texas Eastern Transmission Corp., Shreveport, La., 267 miles, 14-30 inch, gas, Louisiana, Mississippi, Pennsylvania and New Jersey, $50 million, before FPC.

96.5 miles, 30-inch, gas, between Kosciusko, Miss., and Uniontown, Penn.; 9.4 miles of supply laterals; a 10,250 hp compressor station, and 33,360 hp to existing compressor stations, $24.5 million, authorized.

141,780 additional horsepower in existing stations, a new 2,200 hp compressor station, in Louisiana, Mississippi, Pennsylvania, Ohio, Kentucky and Tennessee, authorized.

10 miles, 8-inch, LPG, Lebanon to Todhunter underground storage in Ohio, 62 miles, 8-inch, Tyler to Carthage, Texas, planned.

Texas Eastern Transmission Corporation and Wilcox Trend Gathering System, Inc., gas, compressor stations, $4 million, authorized.

Texas Gas Gathering Corp., Shreveport, 36.6 miles, gas, gathering system in Rodney Field, Jefferson County, Miss. and from North and South Locust Ridge, Lake St. John Field in Tensas and Concordia parishes, La., $855,413, before FPC.

Texas Gas Transmission Corporation, Owensboro, Ky., 92 miles, 30-inch, 19 miles, 26-inch, and 15 miles, small diameter, loop portions of system in Louisiana, Arkansas, Mississippi, Kentucky, Indiana and Illinois; additional horsepower at Pineville, La., Kenton, Tenn., Calvert City, Ky., Slaughters, Ky., Dillsboro, Ind., and Petersburg, Ind., totaling 9,040 hp. $20 million, contract let on 30 miles to Houston Contracting Co.

Texas Illinois Gas Pipeline Company, Chicago, 16,000 additional hp to stations at Lufkin, and Marshall, Texas; Texarkana, Malvern, Searcy, and Biggers, Ark.; Jackson, Mo.; and Hammond. Ill., $3.9 million, before FPC.

Transcontinental Gas Pipe Line Corp., Houston, 204 miles, 36-inch, 107 miles, 30-inch, main line loops in 10 states; 3 intermediate stations: North Carolina, Virginia, Pennsylvania; 2,500 additional hp at six compressor stations; 164 miles, 24-inch from Leidy storage Penn.; 29 miles, 30-inch, New Jersey; gathering lines, Louisiana, 119 miles; 10 meter stations; additions to West Cameron and High Island area, 35-miles, 16-inch, 26 miles, 10-inch, and three gathering meter stations; 45 miles, 16-inch, purchase laterals and 5 meter stations, Louisiana; 67 miles, 10, 12, 20-inch miscellaneous transmission purchase laterals in Texas and Louisiana, 3 meter stations; 51 miles, 36-inch and 1 mile, 30-inch in New Jersey; 51 miles, 10- and 14-inch and 3 meter stations, southeast Louisiana (mainly offshore), $137.3 million. Contracts let on 710 miles to Bechtel Corp., Charman, Allen, Gay & Taylor, Panama Williams, J. P. Neill, H. C. Price, Brown & Root, Hallmac Construction Co. and Glaser Construction Company.

151 miles, 24-inch, 12 meter stations, southeast Louisiana, $14.5, authorized.

2,500 additional hp at four compressor stations, St. Francisville, La.; Laurel, Miss.; Linden, Ala. and Wadley, Ala., $3 million, authorized.

Wells, pipe lines, measuring equipment, stations at Leidy storage in Pennsylvania, $12.5 million, authorized.

149 miles, 36-inch, main loops, 34 miles, 20, 24-inch gathering, compressor stations at Neuces County, Texas and St. Helena Parish, La., additional hp in eight stations, $51 million, before FPC.

Trans-Utah Pipeline, 120 miles, 16-inch, gas main line from Uinta Basin to Salt Lake City, considered.

Transwestern Pipeline Company, Houston, 1,305 miles, 24- and 30-inch, gas, main line, from West Texas and Oklahoma-Texas Panhandle area to Topock, Ariz., $193 million, before FPC.

Trunkline Gas Company, Houston, 204 miles, 26-inch, gas, main line from Tuscola, Ill., to Michigan-Indiana border; 464 miles, 30-inch loops between Longville, La., and Tuscola and 45 miles, 24-inch, in Texas, 183 miles gathering, Louisiana, 3000 additional hp at Longville station, $81.5 million, before FPC.

Underground Storage & Exploration, Upper Darby, Penn., 394 miles, 12-inch LPG, from Moundsville, W. Va. to Newark, N. J., $9 million, approved.

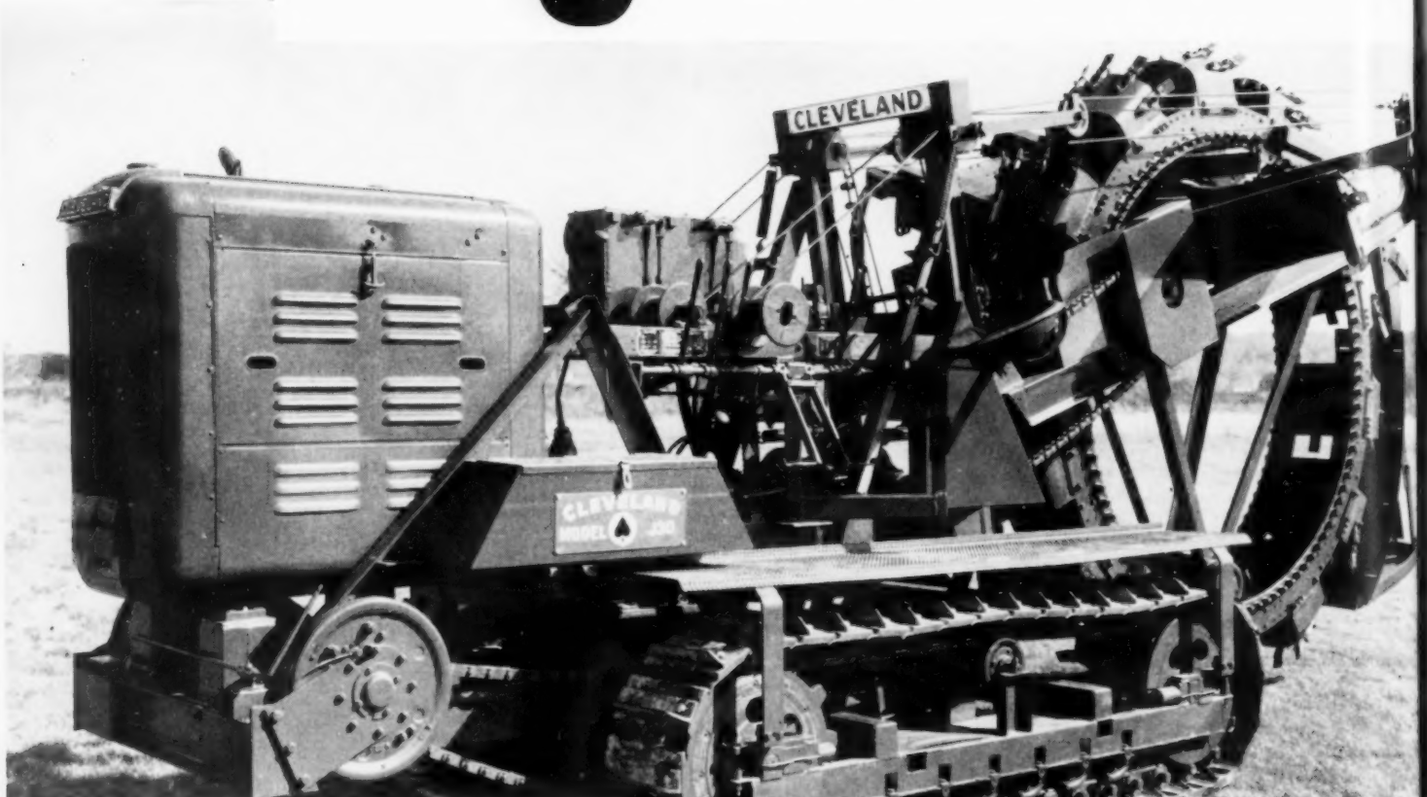
95 miles, 6-8 inch, laterals to Mauch Chunk, Penn., and to Philadelphia, planned.

United Gas Pipe Line Co., Shreveport, La., 203 miles, 30-inch, gas, between New Orleans and Mobile, Ala., $33.7 million, contracts let on 30-miles to O. R. Burden, 38 miles to Williams Bros., and 12 miles to Western Pipe Line, Inc.

Valley Gas Transmission, Inc., Houston, 160 miles, 3 to 8-inch, gas, gathering, in Hidalgo, Brooks, Starr and Jim Wells Counties, Texas, $15 million, before FPC.

Announcing

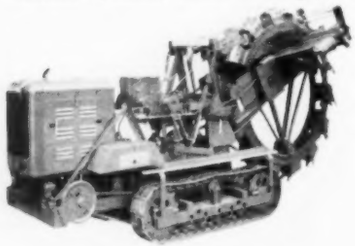
3 GREAT NEW



The J-20

Width over crawlers ..... 4' 10"
Crawler length, C.C. ..... 6' 3"
Overall length .....21' 6"
Width of crawler shoe ..... 10"
Weight ..... approx. 13,500 lbs.
Ground bearing pressure ..... 8.8 psi.
Cuts trench 13" to 24" wide, to 5' 6" deep

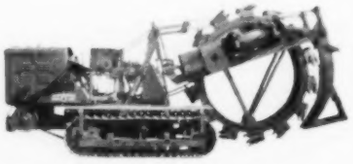
Principal applications:
urban areas, utilities lines, services, extensions, mains, house footings, etc.



The J-30

Width over crawlers ..... 6'
Crawler length, C.C. ..... 6' 9"
Overall length .....22'
Width of crawler shoe ..... 14"
Weight ..... approx. 15,000 lbs.
Ground bearing pressure ..... 6.5 psi.
Cuts trench 13" to 24" wide, to 5' 6" deep

Principal applications:
suburban areas, drainage, utilities, gathering lines, footings, septic tanks, leach beds.



The J-40

Width over crawlers ..... 8'
Crawler length, C.C. ..... 7' 6"
Overall length .....23'
Width of crawler shoe ..... 18"
Weight ..... approx. 18,800 lbs.
Ground bearing pressure ..... 5.6 psi.
Cuts trench 17½" to 30" wide, to 5' 6" deep

Principal applications: trench up to 30" wide—pipelines, waterlines, drainage, irrigation, sewer lines, utilities.

...with the basic Cleveland characteristic ... *Quality*

CLEVELAND TRENCHERS

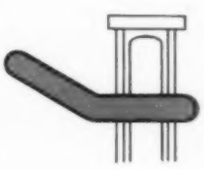
with ...revolutionary new V conveyor

...world's finest trencher crawlers

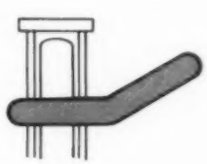
...all operations controlled at operator's seat

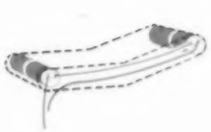
V CONVEYOR ... provides maximum clearance under digging wheel rims ...allows higher heaped loads without clogging ... provides constant elevating angle for faster, higher spoil discharge ... reduces rolling and tumbling ... has stronger torsion-free construction ... employs huskier, longer-lived bearings.

AUTOMATIC CONVEYOR SHIFT ... operator controls hydraulic shifting and positioning of conveyor ...digs past poles, trees, shrubs ... places spoil where needed ... *all* without leaving seat, without interrupting other operations.



DUAL INDEPENDENT CONVEYOR DRIVE ... identical, self-contained hydraulic motor and planetary gear drives in each head-pulley eliminate *all* conveyor chains and sprockets ... reduce belt slippage and wear ... furnish operator fingertip control of conveyor belt direction and speed (215-1,000 fpm) independent of all other operations.





FINEST CRAWLERS ON ANY TRENCHER ... employ double flanged wheels, rollers and sprockets with wide-spaced teeth ... drives on each end of 1½" dia. hardened pins ... completely eliminates pockets for dirt, stones, etc. ... eliminates take-up devices ... gives greater track stability ... lengthens wear life ... sprockets, wheels and idlers ride on sealed ball or roller bearings requiring only 200-hour lubrication ... a tremendously long-lived, trouble-free, easy-rolling crawler track.

BIG 16" x 3" HYDRAULIC STEERING BRAKES ... controlled by suspended-type foot-pedals ... provide simple easy steering and maneuvering.

HYDRAULIC CRUMBING SHOE ... now, crumbing shoe advantages (cleaning, grading) are practical even in crowded digging ... Cleveland's hydraulic shoe control (optional, extra) pivots shoe back and up to allow setting wheel to required depth at walks, drives, underground obstructions, etc.

Engine, Hoist, Wheel, Shoe, Conveyor Speed—Direction—Shift, Crawlers

...Every Operation Controlled at Operator's Seat.

Good

The CLEVELAND TRENCHER Co.

Everywhere

Pioneers of the Modern Trencher

20100 St. Clair Avenue
Cleveland 17, Ohio

International

ACT Oils, Ltd., Montreal, 400 miles, crude, Dawson Creek, B. C., to Bella Coola, B. C., before B. C. government.

Alaska-Yukon Refiners and Distributors, Ltd., Edmonton, Alta., 150 miles, products, serving Alaska and Yukon territory, $3.5 million, planned.

Alberta Natural Gas Company (Jointly owned by Westcoast Transmission Co. and Alberta & Southern Gas Co. Ltd.) 36-inch, gas, Alberta border to British Columbia-Idaho border, supply gas to Pacific Gas & Electric Co., $40 million, planned.

Bituminous Oil Pipeline Co., Calgary, 250 miles, crude, from Athabasca tar sand plant in northeastern Alberta to Edmonton, approved.

Burmah Oil Co., Ltd., 850 miles, crude, 20 inch, from Nahorkatiya to Calcutta, India, planned.

Cartier Gas Corp. (St. Maurice Gas, Inc., and Consumers Gas Co., Toronto), 170 miles, gas, Montreal to Quebec City, planned.

Colombian Petroleum Company, 68 miles, 12-inch, crude, Cicuco field to Covenas, planned.

Consolidated Gathering Systems, Ltd., Calgary, 198 miles, crude, Sturgeon field to Edmonton, planned.

Development and Resources Corp., 70 miles, 8 inch, gas, from Agha Jari oil field to Ahwaz, Iran, planned.

Elburz Oil Corp., 1000 miles, crude, from Central Iran to Alexandretta, Turkey, $450 million, planned.

Entre Nazionali Idrocarburi, Rome, Italy, crude, from Qum field in Iran to the Mediterranean Sea, considered.

Foothills Pipe Line, Ltd., 500 miles, 12 to 16-inch, LPG, from Alberta to Pacific Coast, $80 million, considered.

Hydrocarbons Pipeline, Ltd., Winnipeg, Manitoba, 880 miles, 6-8 inch, products, from Edmonton to Winnipeg, $35 million, partial authorization.

Independent Pipe Line Co., 2,019 miles, 34-36-inch, crude, Edmonton to Montreal, 23,000 pump horsepower, $395 million, before Borden Commission.

Interprovincial Pipe Line Company, 350-mile extension from Toronto to Montreal, looping line from Edmonton to Toronto, crude, $240 million, considered.

Mid-Continent Pipe Lines, Ltd., 1500-mile, 30-inch crude, Edmonton to Chicago, planned.

NATO, 211 miles, crude, 6-inch, between Malatya-Cetinkaya-Erzincan, Turkey, $6 million, bids asked.

National Iranian Oil Co., 146 miles, 6 inch, crude, from Azna to Isfahan, Iran, $5 million, planned.

1000 miles, 38 inch, crude, from central Iran to the Turkish Mediterranean coast, considered.

Peace River Oil Pipe Line Co., Ltd., 70-mile, crude, Swan Hills to Iosegun Junction, approved.

Pembina Pipe Line, Ltd., Edmonton, 1,200 miles, LPG, from Alberta gas fields to eastern Canada, planned.

Petroleos Mexicanos, 38 miles, 4 inch, products, from Mexico City to Toluca, $500,000 planned.

126 miles, 4, 6 and 8 inch, products, from Mexico City to Cuernavaca and Puebla, $2.5 million, planned.

Pipelines of Puerto Rico, Inc., 95 miles, 8-inch, products, Penuelas to San Juan, Puerto Rico, planned.

Sociedad Nacional de Oleoductor, 75 miles, crude, from Santiago-to-Valparaiso, $3 million, planned.

Societa Nazionale Metanodotti, 200 miles, 18-inch, crude and products, Genoa to Milan-Cremona-Torino, Italy, and Geneva, Switzerland, considered.

Sui Gas Transmission Co., Multan, Punjab, India, 145 miles, 8-inch, gas, from Sylhet to Dacca, East Pakistan, $9 million, considered.

130 miles, 16-inch, gas, main line, Multan to Lyallpur, planned.

Trans-Europe Pipe Line, 700 miles, 30 inch, main trunk, crude, from Mediterranean to northern Europe, considered.

Trans-Prairie Pipelines, Ltd., Edmonton, crude line, from Weyburn field to Regina-Moose Jaw areas, $5 million, considered.

Union Gas Company of Canada Limited, 45 miles, 8-inch, gas, main, Stratford to Goderich, Ontario; 10-miles, 8-inch, main, to Amhertburg; 10-miles, 12-inch, lateral, Galt to Brantford, planned.

Van Tor Oil & Exploration Co., Vancouver, B. C., 25 miles, gas, Vancouver Island to mainland, planned.

Westcoast Transmission Company, Ltd., 174 miles, 30-inch, gas, Savanna Creek gas field, Alberta, to British Columbia border, $45 million, planned.

650 miles, crude, from Peace River area to Vancouver, $100 million, planned.

Williams-McWilliams Industries, Inc., New York, 441 miles, 6-inch, crude, Villa Montes, Bolivia to Villa Hayes, Paraguay, considered.

Yacimientos Petroliferos Fiscales, Buenos Aires, Argentina, 621 miles, 12-inch, products, Mendoza to San Lorenzo, Argentina, $19 million, planned.

281 miles, 12¾ inch, crude, Pichanal to San Miguel Tucuman to Techint, S. A., planned.

450 miles, 16-inch, crude, from Neuquen Province to Bahia Blanca, planned.

1300 miles, gas, from Comodoro Rivadavia Field to Buenos Aires, $200 million, agreement signed with Williams Bros. Co.

Pipe Line Contractors Association Officers

Newly elected officers of the Pipe Line Contractors Association are, left to right, R. D. Sheehan, Sheehan Pipe Line Construction, Tulsa, first vice president; John H. Williams, Williams Brothers Company, Tulsa, president; M. S. Williams, Panama-Williams Corporation, Houston, second vice president, and Felix Johnson, Trojan Construction Company, Oklahoma City, treasurer. Approximately 700 persons attended the 11th annual PLCA convention in Bal Harbour, Fla., January 12-15. Next year's meeting has been scheduled for the Ambassador Hotel, Los Angeles, January 31-February 3.

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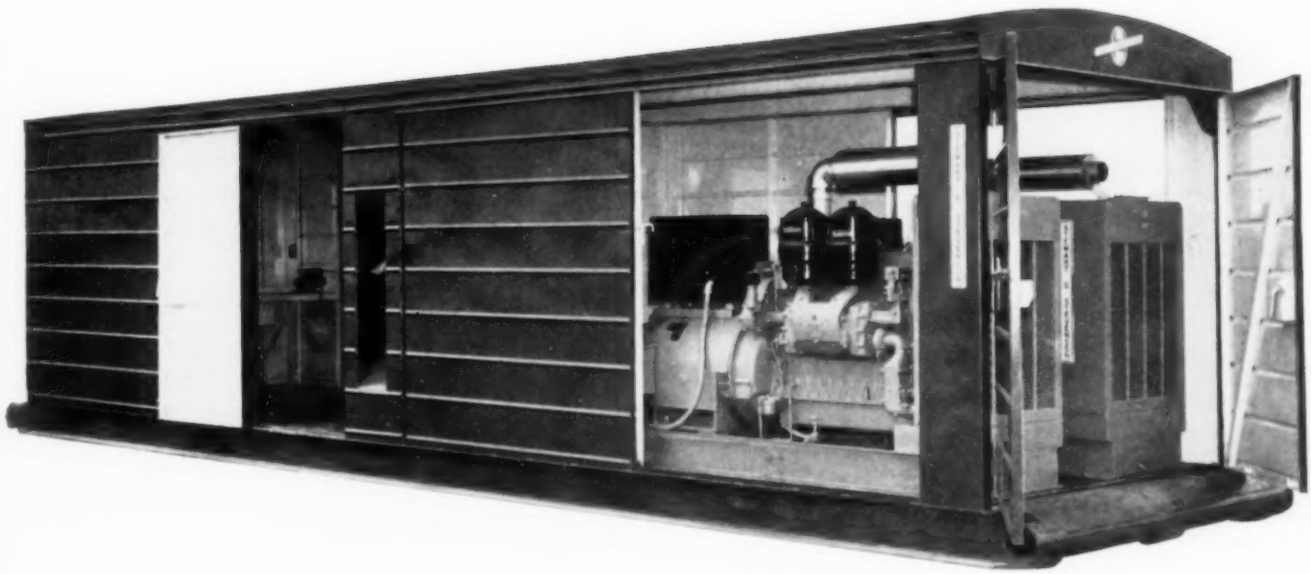

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What's Happening

among MEN in the INDUSTRY

J. L. Parrish, Jr.

T. K. Davis

Tennessee Gas Pipeline Company, which was formed as a division of **Tennessee Gas Transmission Company** in January, has promoted **T. K. Davis, J. L. Parrish, Jr.,** and **B. J. Whitley, Sr.** to vice presidents. **L. W. A. Campbell** and **O. H. Simonds,** vice presidents of TGT, were named vice presidents of the pipe line company.

Tennessee Gas Pipeline Company will operate the parent firm's pipe line system and gas transmission business.

B. J. Whitley

R. Clyde Hargrove has joined **Bechtel Corporation** as assistant to vice president **E. J. Mahoney, Jr.** He will assist Mahoney in pipe line projects and business development and advise department heads on regulatory questions concerning pipe lines. Hargrove joined the firm six months ago and has been named a vice president of Bechtel International Corporation.

As a partner in the law firm of Hargrove, Guyton, Van Hook and Hargrove, Shreveport, he formerly represented clients at hearings before the Federal Power Commission.

Sam L. Jackson has been appointed manager of operations in the supply and transportation department of **Standard Oil Company (Indiana).**

Jackson, who has been transportation manager succeeds **Richard E. Nelson, Jr.,** named president of the newly organized Amoco Trading Corporation. **Creed F. Gearhart** succeeds Jackson and **Lyle W. Ewing, Jr.,** replaces Gearhart as chief engineer.

Jackson has been with Standard since 1928. He became manager for products pipe lines in 1951 and was named transportation manager in 1956. Gearhart joined Standard's affiliate **Service Pipeline Company** in 1946. He was made chief engineer for Standard in 1951. Ewing has been with the company for 10 years. He served as assistant chief engineer and in 1956 was appointed superintendent of product movement.

The appointments of **J. E. Thompson** as assistant chief engineer and **R. E. Evans** as general superintendent of construction have been announced by **Natural Gas Pipeline Company of America.**

Thompson, who will assist **M. J. Paul,** has been superintendent of pipe line construction since 1953. Evans, compressor station construction superintendent since 1953, will head both departments.

Both men have served in a number of supervisory positions prior to the appointments which are effective immediately.

John M. Kindle has been named vice president in charge of transmission for the **Lone Star Gas Company.** Kindle who has been with the company for 33 years, succeeds **Julian L. Foster** who retired at the end of the year. He has served as superintendent of operations in the transmission division and gas supply division of Lone Star Gas Company and Lone Star Producing Company since 1954. Previously he had been superintendent of the gasoline department.

Foster had been with the company for 40 years joining Lone Star in 1918 as an engineer. He was appointed assistant general superintendent of operating department in 1921, chief engineer of transmission in 1926 and was made general superintendent in 1935. He was elected vice president in charge of transmission in 1954.

Buckeye Pipe Line Company announces the appointment of **G. Frank Barnes** as administrative assistant to the president in the company's New York office.

Barnes, since 1948, has been superintendent of Buckeye's subsidiaries, **Northern Pipe Line Company** and **New York Transit Company, Inc.** He also had 15 years experience in field operations.

Consolidated Natural Gas Company announces the appointment of **A. Gordon Hanau** as manager of its System Insurance department with headquarters in New York City.

Hanau joined Consolidated Natural in 1957, and previously was insurance manager for the Missouri-Kansas-Texas Railroad. He is a member of the Insurance Committee of the American Gas Association.

G. E. Hathaway has been named division mechanical supervisor for the products pipe line division of **SOHIO Pipe Line Company's** transportation department.

He will be responsible for the supervision of the department's mechanical, electrical, and electronic equipment maintenance functions. Hathaway joined Sohio in 1947 and became station foreman in 1955. He served as staff assistant to the superintendent from 1956 until his recent assignment which was working with an engineering task force studying the entire transportation department's maintenance program.

Texas Gas Transmission Corporation announces the appointment of **J. W. Carneal** as director of sales and industrial development. An employe of Texas Gas since 1949, Carneal had been assistant director of sales and customer relations since 1956. He joined the company as soil technologist and served as chief soil conservationist, manager of company housing, assistant superintendent of pipe line department, and industrial representative.

J. W. Carneal

In his new post he will broaden his activities in sales and customer relations and continue direction of work in the industrial field.

R. W. Lee has been named assistant superintendent of **Continental Pipe Line Company's** Oklahoma-Kansas-Illinois district.

Formerly a staff member for Continental, he will succeed **L. C. Secrest,** who has transferred to Wichita Falls, Texas, as North Texas district superintendent.

Texas Natural Gasoline Corporation elected **Harold G. Teverbaugh** to the board of directors and renamed **John T. Oxley, Mark J. Millard, Eugene McElvaney, Roger S. Randolph** as directors.

Oxley, Teverbaugh, and **Forrest S. Warren** were named vice presidents; Randolph, secretary; **W. Philip Wyrick,** treasurer; **L. A. Stuewer,** assistant secretary and treasurer; and **Stacy Philp,** assistant secretary.

Ben H. Hamilton, with over 10 years experience in the LPG industry, has been named vice president of **Southern Gas and Fuel Co.,** an associate company of **Beacon Petroleum. George Barber, Jr.,** has been appointed the new district manager of Southern Gas operations.

Hamilton formerly was assistant secretary and treasurer of Southern Gas and Fuel and **Progas Co.,** a Beacon affiliate.

R. A. Minter, chief engineer for **Lone Star Gas Company,** was elected president of the petroleum engineer's club of Dallas succeeding **K. F. Anderson,** chief of Dallas Field Office, Bureau of Mines.

Other officers for 1959 include **Aurel E. Smith, British-American Oil Producing Company,** executive vice president; **Robert K. Winters, Atlantic Refining Company,** first vice president; **Clarence M. Netherland, H. J. Gruy and Associates,** second vice president; and **Donald F. Taylor, Jr., Northern Area Otis Engineering Corporation,** secretary-treasurer.

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William E. Ferguson, vice president and manager of production of **Ohio Fuel Company** has retired after 41 years in the natural gas industry.

W. E. Ferguson

A member of the board of directors and director and member of the Preston Oil Company, Ferguson had been in charge of Ohio Fuel's production operations and underground storage program. He began his career with **Logan Gas Company** in 1917 as a draftsman. He became chief engineer in 1924 and later became chief civil engineer with Ohio Fuel. In 1950 he was promoted manager of production, and in 1952 was elected vice president of the company. He was elected to the board of directors in 1956.

C. R. Elder, Jr. has been elected a vice president and director of **Sohio Pipe Line Company.**

Elder joined Sohio in 1947 as an engineer. He served as assistant division superintendent and superintendent of the Southwestern division, and as superintendent of the Tri-State division before becoming general superintendent.

James R. Polston has been named superintendent of product movement in the supply and transportation department of **Standard Oil Company (Indiana).**

He has been with the company for over 10 years and has been head engineer in the supply and transportation-operations-engineering department.

He joined the firm in 1948 as junior engineer in products pipe line department at Chicago. After serving as district engineer at Rensselaer he returned to Chicago and was named section-head engineer. In 1956 he became associate engineer of supply and transportation-operations-engineering department and was made head engineer in 1957.

R. A. Ransom Company, Inc., Consulting Engineers, has expanded its activities opening another office, located in New York City. **Lester Simon,** vice president and director of the company, will be in charge of the new headquarters.

The new office will be staffed to carry on engineering and business consulting services.

Elmer O. Mattocks, director of Department of Technical Services of the **American Petroleum Institute,** was presented with an award of merit at the American Gas Association's 40th annual meeting.

He was honored specifically for his service on the committee on LPG Utility Code.

J. Howard Stark has been named labor relations advisor for **Sunray Mid-Continent Oil Company.** He will assist in labor relations work for **Mid-Continent Pipe Line Co.** and **Sunray Mid-Continent D-X Sunray Oil Co.**

Stark spent two years with the U. S. Department of Labor's Wage and Hour division in Shreveport and was field manager for the National Labor Relations board 16th regional office at Fort Worth before joining Sunray Mid-Continent.

E. P. Shanahan has been named vice president and comptroller of the **Houston Corporation** and its subsidiaries, **Houston Texas Gas and Oil Corporation** and **Coastal Transmission Corporation.**

He has been associated with Price Waterhouse & Company, independent public accountants, since 1940.

El Paso Natural Gas Company has opened a geological and land office at San Antonio, Texas. **Hal S. Dean** has been named manager of the office. He has worked with Magnolia Petroleum Company and Edwin W. Pauley, an independent oil producer.

The **Pipe Line Contractors Association** has elected officers and directors for 1959. **John Williams, Williams Brothers Company,** has been named president. **Robert Sheehan, Sheehan Pipe Line Construction,** is first vice president. **M. S. Williams, Panama-Williams Corporation,** was elected second vice president and **Felix M. Johnson, Trojan Construction Company,** is the new treasurer.

Directors include **R. P. Gregory, Houston Contracting Company; Jack Gray, Grayco Construction, Inc.; E. G. Morrison, Western Pipe Line, Inc.; O. R. Burden, O. R. Burden Construction Corp.; T. A. Hester, Oklahoma Contracting Company; James P. Neill, J. P. Neill & Company; H. C. Price, H. C. Price Company** and **R. B. Somerville, Somerville Construction Company. Richard A. Gump** remains executive secretary and **Hailey A. Roberts,** assistant executive secretary.

Leonard Crude Oil Company has elected **John C. Horning** a vice president. He will continue to serve as manager of operations. Prior to his election, Horning had been a director and manager of field operations.

Spencer & Partners Consulting Engineers has been named by **National Iranian Oil Company** as consultants for anti-corrosion measures on oil pipe lines and associated installations.

DEATHS

Clarence Edward Christie, 64, supervisor of pipe line operations for the Scurlock Oil Company and retired employe of Sinclair Pipe Line Company died of a heart attack December 21, 1958.

After 36 years with Sinclair, Christie retired in 1958. In December he joined Scurlock Oil Company.

Major Alexander Forward, managing director of American Gas Association for 22 years before retirement in 1949, died Dec. 21 at Coral Gables, Fla.

He joined the AGA in 1923 as secretary-manager and later became managing director.

WHO'S MEETING WHERE

February

Southwestern Legal Foundation, 10th annual institute on the law of oil, gas, and taxation, Southwestern Legal Center, Dallas, February 11-13.

NACE, Corrosion Short Course, Mayo Hotel, Tulsa, February 11-13.

NACE, Canadian Western Regional meeting, Calgary, Alberta, Feb. 12-13.

American Institute of Mining, Metallurgical, and Petroleum Engineers, annual meeting, Sir Francis Drake Hotel, San Francisco, February 15-19.

Pipe Line Contractors Association of Canada, fifth annual convention, Castle Harbour, Bermuda, February 25-28.

ASTM, Southwest District, annual meeting, Engineering & Scientific Society, Houston, February 26.

Natural Gasoline Association of America, Permian basin regional meeting, Scharbauer Hotel, Midland, Texas, February 27.

March

ASME, gas turbine power conference & exhibit, Netherlands-Hilton Hotel, St. Louis, March 1-5.

University of Oklahoma, school of petroleum engineering, gas processing conference, Norman, Okla., March 4-5.

NGAA, gulf coast regional meeting, Robert Driscoll Hotel, Corpus Christi, March 6.

ASME, gas turbine power conference and exhibit, Netherlands-Hilton Hotel, Cincinnati, March 8-12.

Midwest Gas Association, annual meeting, Hotel Fort Des Moines, Des Moines, Iowa, March 9-11.

NACE, 15th annual conference, Sherman Hotel, Chicago, March 16-20.

New England Gas Association, annual meeting, Hotel Statler, Boston, March 19-20.

ASME, instruments and regulators conference, Case Institute of Technology, Cleveland, March 29-April 1.

April

Instrument Society of America, second national symposium on chemical and petroleum instrumentation, St. Louis, April 6-7.

AGA Operating Section Distribution conference, Netherland-Hilton Hotel, Cincinnati, April 6-9.

American Welding Society, 40th annual convention, Sherman Hotel, Chicago, April 6-10.

ASME, hydraulics conference, University of Michigan, Ann Arbor, Mich., April 13-15.

Southwestern Gas Measurement Short Course, University of Oklahoma, Norman, Okla., April 14-16.

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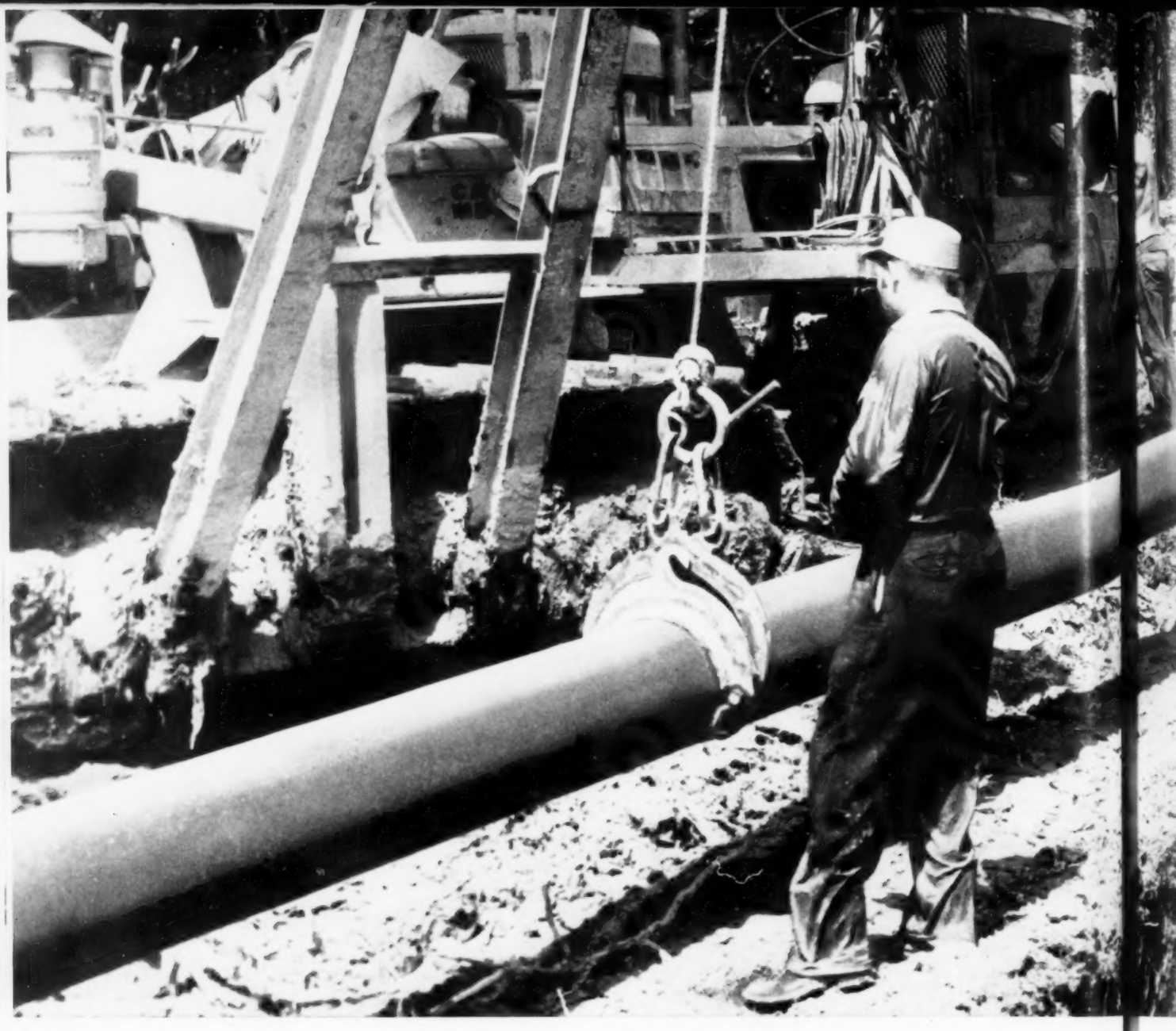

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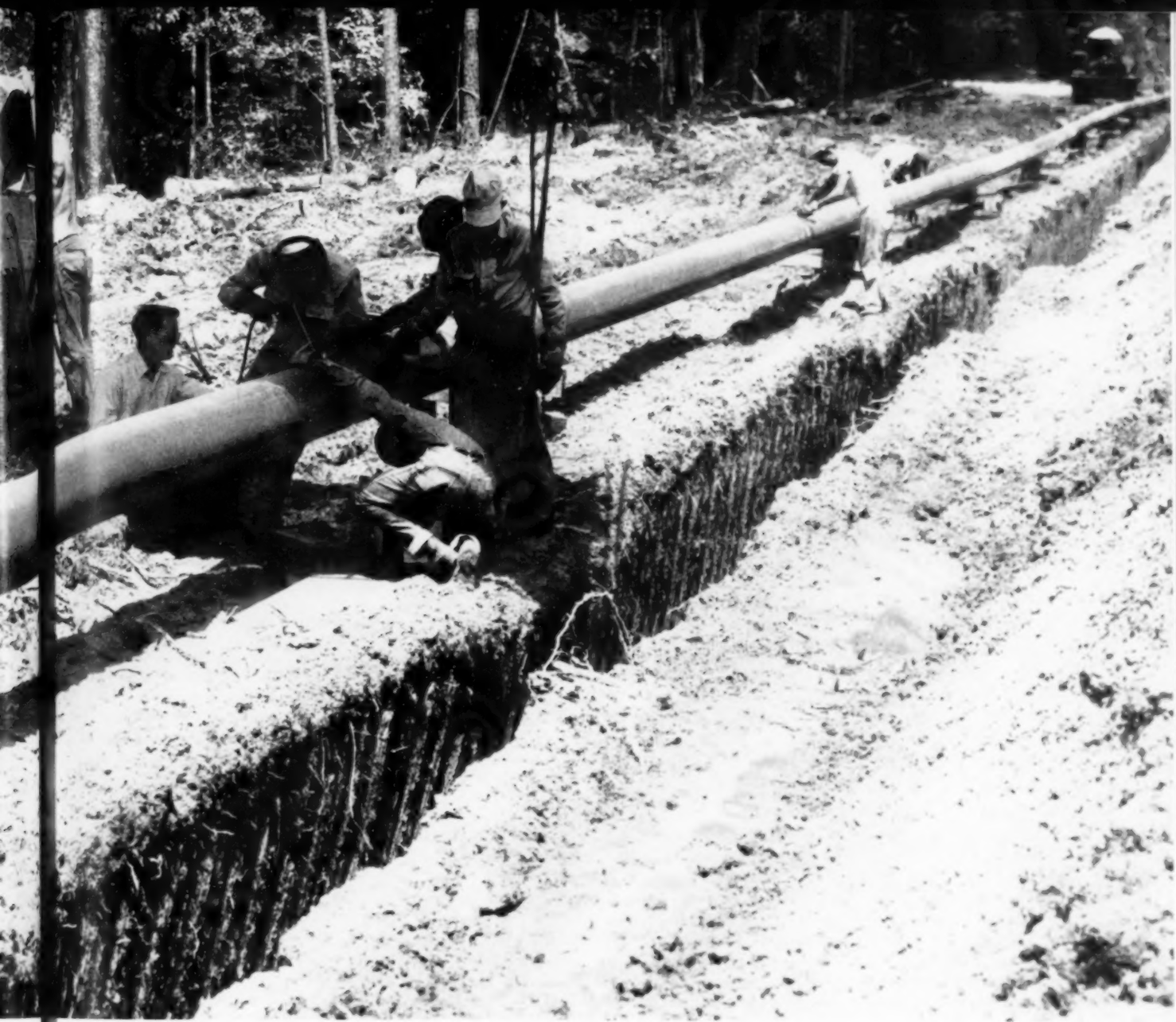

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What's Happening among SERVICE and SUPPLY MEN

Fisher Research Expands Plant Facilities

Fisher Research Laboratory, Inc., recently completed an extensive program of new construction and modernization at its existing plant location. Increased laboratory, administrative, and shipping requirements were provided with the construction of 4,000 square feet of plant space.

Youngstown Sheet and Tube Co. Elects Four New Vice Presidents

Board of directors of Youngstown Sheet and Tube Company elected four new vice presidents. Robert P. Bremner is vice president, raw materials; Donald S. Day becomes vice president, traffic; Dr. Karl L. Fetters is vice president of research and development; and James D. Sloan has been made vice president, purchasing.

Bremner has been with the firm since 1948. In 1951 he was promoted to vice president in charge of operations and in 1955 was made manager of mining operations. Day joined the company in 1954 as assistant general traffic manager; he became general traffic manager in 1956. Fetters, who joined Youngstown in 1936 as a hearth metallurgist, was named assistant to vice president in charge of operations in 1950 and became assistant vice president in 1956. Sloan, a 30 year veteran with the company, was named purchasing agent in 1945 and in 1956 he assumed supervision of all activities of the purchasing department.

A. O. Smith Corporation Forms Plastics Division

A. O. Smith Corporation has formed a reinforced plastics division with James F. Donnelly, Sr., as general manager. The new division will manufacture reinforced plastic pipe and other products which would have a wide application in the oil, chemical, gas and liquid petroleum gas industries.

J. F. Donnelly

A. O. Smith research laboratories have spent more than five years developing and field testing the pipe and various other reinforced plastic applications.

Donnelly formerly was assistant general manager of the A. O. Smith Corporation's Permaglas division.

Miller and Lakey Named U. S. Steel Representatives

William J. Miller has been appointed field representative at Fort St. John B. C. and Wilburn D. Lakey was made field representative at Brookhaven, Miss. for U.S. Steel's Oil Well Supply Division.

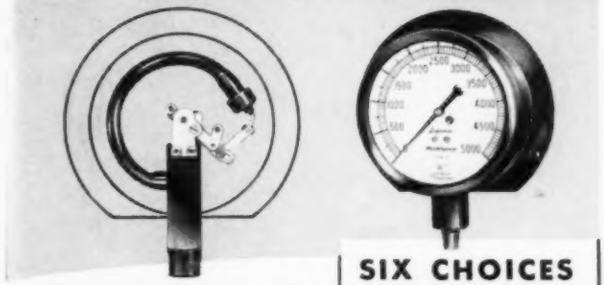
Lakey was employed by Oilwell in 1953 and was named field representative at Houston in 1955. Miller joined the company in 1956 and was transferred to Calgary in 1957.

Floyd Anderson Selected Chief Metallurgist for Gardner-Denver

Floyd R. Anderson, administrative assistant of the Denver division of Gardner-Denver, has been appointed chief metallurgist of the firm.

He joined the firm in 1925, served as metallographist for Colorado Fuel and Iron Co. from 1931 to 1934 and that year returned to Gardner-Denver to become an assistant metallurgist. He was named head of the department in 1937.

STAINLESS!



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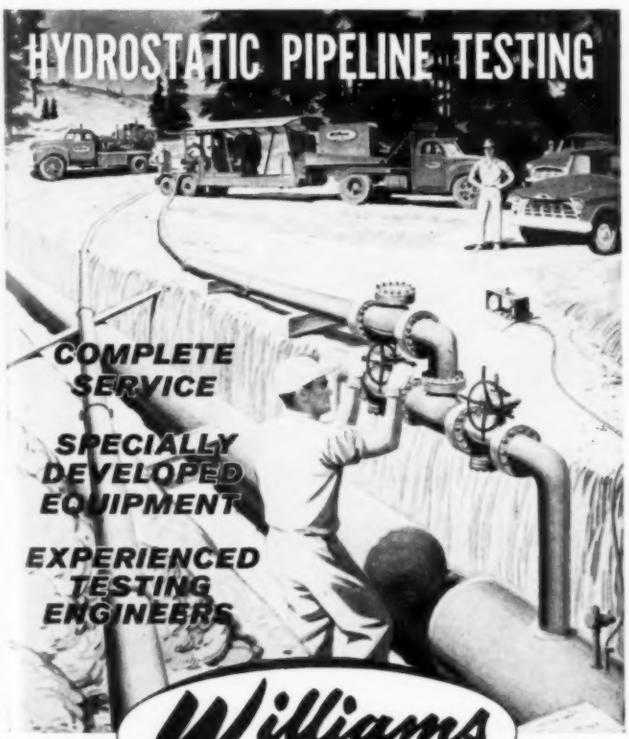

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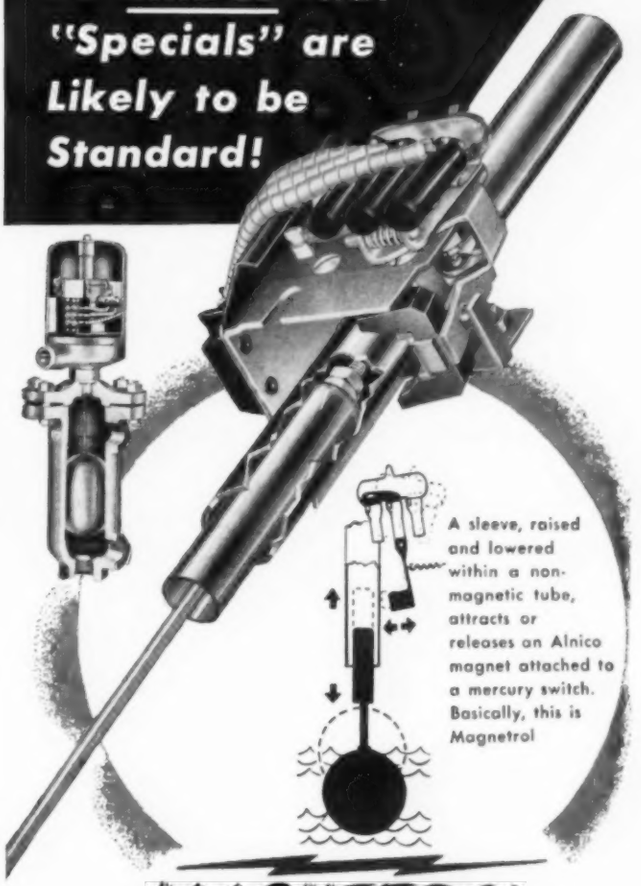
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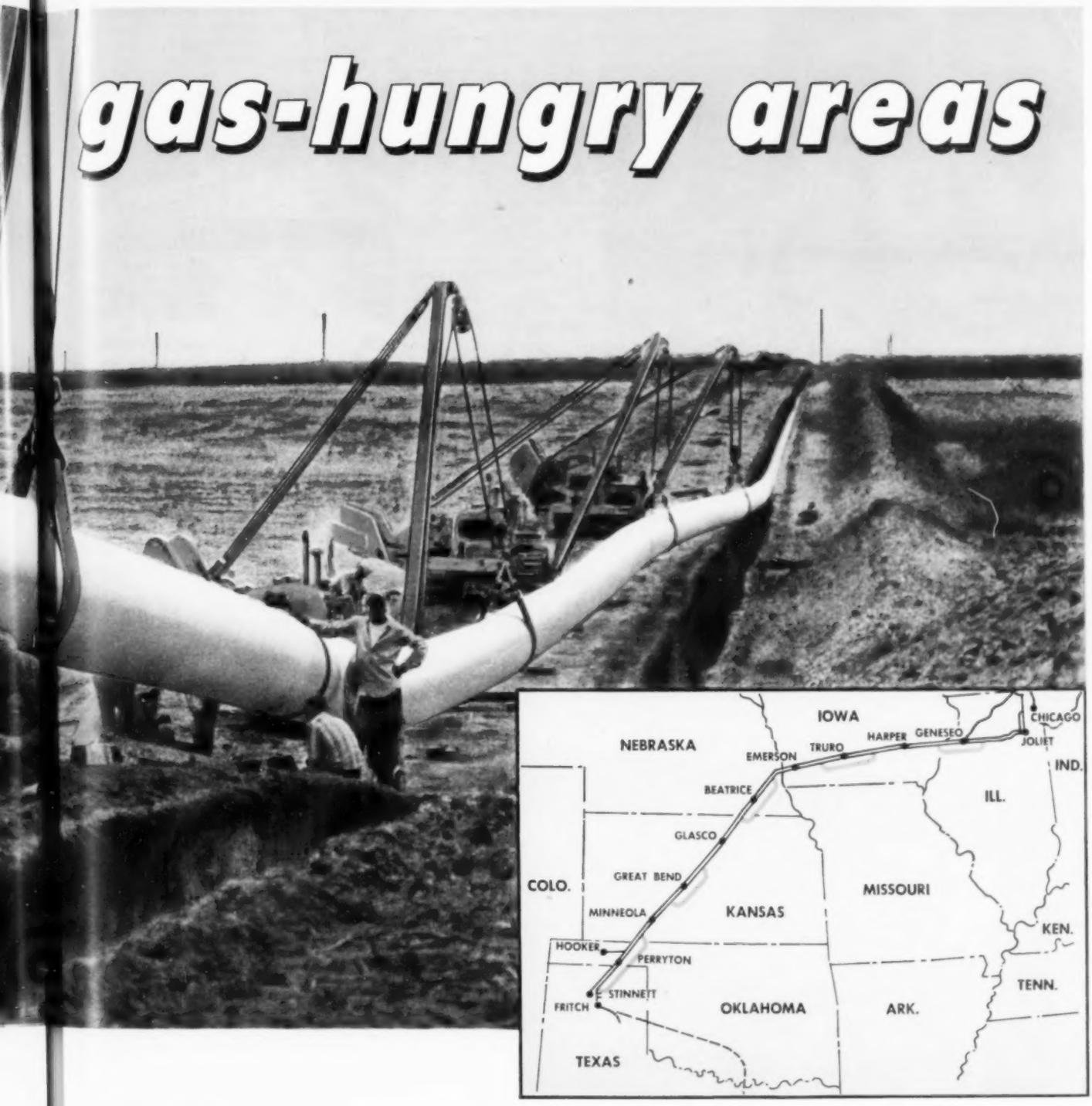
Natural Gas Pipe Line Company of America completes 513 miles of looping line in record time

Additional supplies of natural gas from the Panhandle and north-central areas of Texas will soon flow through new lines, and initial deliveries to the Iowa, Illinois, Wisconsin and Indiana markets will be increased by 100 million cubic feet per day. Nearly five hundred miles of 36″ pipe and twenty miles of 26″ pipe have been laid . . . will bring new gas supplies to the midwestern markets. In furnishing a little more than half this pipe, A. O. Smith Corporation is proud to have helped serve Natural Gas Pipe Line Company of America and its tremendous markets.

gas-hungry areas



For 30 years . . .

A. O. Smith line pipe has always been manufactured to a high standard of quality . . . precisely controlled at every step of production. That's why A. O. Smith pipe made and installed in 1928 is still in operation. That's why so much A. O. Smith pipe has been used on so many important pipeline projects.

Through research A.O. Smith *. . . a better way*

A.O.Smith
CORPORATION

TUBULAR PRODUCTS DIVISION
Milwaukee 1, Wisconsin

Chicago 3 • Dallas 35 • Houston 2 • Los Angeles 17 • Midland 5, Texas • New Orleans 12 • New York 17 • Tulsa 3 • A. O. Smith INTERNATIONAL S. A., Milwaukee 1, Wisconsin, U. S. A.

J. A. Goodnough

William Dumar

Dumar and Goodnough Named Sales Engineers for Clark Bros.

William Dumar and Joseph A. Goodnough have been appointed sales engineers for Mid-Continent area for Clark Bros. Co.

Dumar has been with Clark since 1950 and has held posts in the service parts and engine sales departments. Goodnough joined Clark in 1955. Prior to his new appointment he was an application engineer.

William S. Barnum Promoted By Kaiser Steel Corporation

William S. Barnum has been appointed assistant manager of sheet and strip sales at Kaiser Steel Corporation's general sales office.

He has been with the sales department since 1951. Prior to his new appointment he had been sales representative at the company's southern district sales office in Los Angeles. In his new position he will serve as assistant to O. D. Hale, manager of sheet and strip sales.

Allis-Chalmers Manufacturing Co. Names Compressor Sales Manager

Wainwright Holt, Jr., has been appointed sales manager of centrifugal and axial compressors and S. B. Lamica has been named manager of the Jacksonville, Fla. district of Allis-Chalmers Manufacturing Company.

Holt joined Allis-Chalmers in 1951 and has been a representative for petroleum and chemical sales in the New York district. Lamica succeeds J. T. Graham, who has been named supervisor of sales training. Lamica has been a sales representative in Allis-Chalmers Tampa district since 1952.

Jones & Laughlin Announces Sales Organization Changes

Several changes in the field sales organization of Jones & Laughlin Supply Division have been announced.

L. E. Tucker, salesman, has been transferred from El Dorado, Ark. to New Orleans. C. S. Wood, salesman, has been transferred from Odessa, Texas, to Dallas. R. F. Bunce, salesman at Lafayette, La., has been assigned to Midland, Texas. P. C. Smith, assistant store manager, Morgan City, La. has been promoted to salesman and transferred to Lafayette.

W-K-M Names Chance Chief Metallurgist

M. R. Chance has been appointed chief metallurgist for W-K-M, division of ACF Industries, Inc.

He will be responsible for all metallurgical functions. Chance came to W-K-M after six years with the Reed Roller Bit Company. Prior to that he was with the United States Army Ordnance Research and Development branch in Washington.

H. A. Lister

Jerry Johnson

T. D. Williamson Appoints Two District Managers

T. D. Williamson, Inc., has opened a branch office in Houston and named a factory representative in Monroe, La. H. A. Lister, previously division pipe line superintendent for the Champlin Oil and Refining Company, becomes Houston district manager. The new Houston office will provide sales service and rental equipment for pipe line companies in the Gulf Coast area.

Jerry Johnson, formerly with Tod Pazdral Pipeline Specialties, will be factory sales representative covering the Monroe-Baton Rouge-Shreveport-Birmingham-Atlanta area.

"Scram, Pals! They're turning the gas in two months ahead of schedule!"

CROSE EQUIPMENT ALWAYS COMPLETES A JOB FASTER!

Speed means economy — and more profit — in pipeline construction work. Rugged Crose pipeline construction equipment is designed for speed and dependability . . . makes any job go faster . . . anytime . . . anywhere!

Crose MANUFACTURING COMPANY, INC.
2765 Dawson Road • Phone WEbster 6-2171 • Tulsa, Oklahoma • BRANCH OFFICES: Houston • Denver • Elizabeth, N. J. IN CANADA: Crose-Curran Ltd., Edmonton, Alberta

The New Model 412 Pressure Relief Valve

This new, improved Kinzbach Model 412 relief valve, for handling oil and heavier products at refineries and on pipelines, has a ball seated pilot valve. It is usually dead weight loaded, but can be spring loaded.

Among numerous advantages of this new valve are its dependable, positive action, with instantaneous opening and positive, automatic resealing. This is a simple, rugged valve easily tested that has high capacity and requires no pressure accumulation for full lift.

Available in 5 sizes, and four ratios in working pressures to 1000 p.s.i. Write for new catalog on all Kinzbach relief valves.

KINZBACH TOOL CO. INC

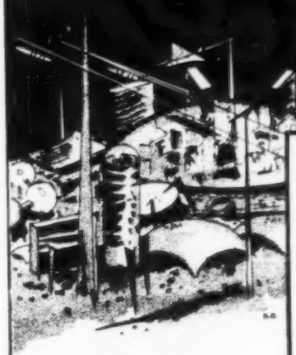
Export Office: 74 Trinity Place, New York, N. Y.

KINZBACH TOOL CO., INC., P. O. BOX 277, HOUSTON, TEXAS

DESTINATION: TOMORROW!

IN FUTURE YEARS PIPELINES AND GAS MAINS PERIODICALLY INSPECTED FOR BREAKS IN THE COATING BY THE P/D WILL STILL BE LEAK-FREE AND OPERATING.

THE PEARSON-TYPE DETECTOR IS WELL KNOWN TO INDUSTRY HOWEVER, THE P/D IS AN ALL TRANSISTOR INSTRUMENT THAT CAN BE USED TO LOCATE DISCONTINUITIES IN THE COATING OF BURIED PIPELINES - TO LOCATE ELECTRICAL CONTACTS ON THOSE LINES - AND TO EFFECTIVELY LOCATE THE LINES THEMSELVES. ALL THIS, WITHOUT DIGGING OR UNCOVERING ANY PORTION OF THE LINE. WHEN YOU USE THE P/D YOU FIND THE HOLIDAY - THE SHORT - THE PIPE - AND, YOU SAVE TODAY, TOMORROW, AND TOMORROW.



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Electronic Detectors for every Industry

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BIG THREE

WELDING SUPPLY CO.

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PORTABLE ROTARY AIR COMPRESSORS

(Designed for the pipeline industry)

TWIN DRILLS

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TURNING TOOLS AND WELDING POSITIONERS

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DALLAS, ODESSA, LUBBOCK, BORGER, EL PASO, LONGVIEW, ALBUQUERQUE, FARMINGTON

CONTROL PARAFFIN

with

BrakeSol

at

LOW, LOW COST!

NOW is the time to set up a "control program" with the constant injection of economical BrakeSol. . . . the chemical that holds paraffin in suspension from formation to refinery.

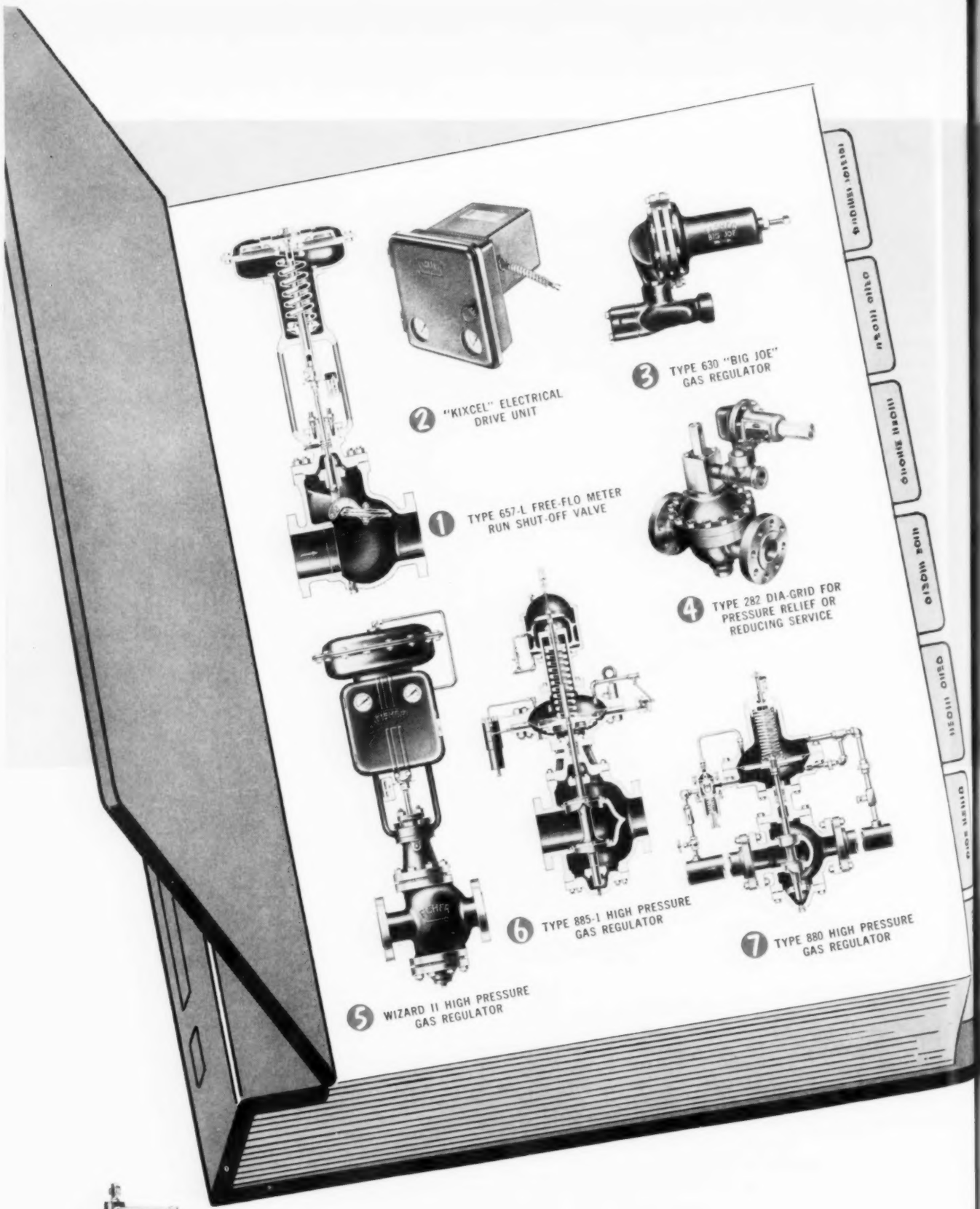
BrakeSol is the most effective chemical for treating all types of paraffin conditions. It is approved by refiners . . . contains no chlorinated solvents or other organic halides or sulphides. Contact your nearby BrakeSol Treating Engineer or Supply Store for information on how your paraffin problems can be eliminated economically.

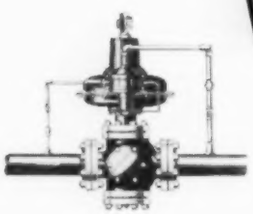
See our Exhibit at the IPE.

BrakeSol INC.

P. O. BOX 9506 • OKLAHOMA CITY, OKLA.

EXPORT DISTRIBUTOR: THE NATIONAL SUPPLY CO., EXPORT DIVISION


1 TYPE 657-L FREE-FLO METER RUN SHUT-OFF VALVE
2 "KIXCEL" ELECTRICAL DRIVE UNIT
3 TYPE 630 "BIG JOE" GAS REGULATOR
4 TYPE 282 DIA-GRID FOR PRESSURE RELIEF OR REDUCING SERVICE
5 WIZARD II HIGH PRESSURE GAS REGULATOR
6 TYPE 885-I HIGH PRESSURE GAS REGULATOR
7 TYPE 880 HIGH PRESSURE GAS REGULATOR



IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD...CHANCES ARE IT'S CONTROLLED BY...

The *FISHER/MAN'S* Guide to

SOLVING THE GAS MAN'S PRESSURE PROBLEMS

at Town Border Stations

The normal daily use of gas in the average town or city creates several peaks or valleys in the gas volume needed to meet the demand. At the "City Gate" it's necessary to have properly designed regulators that can dependably maintain the pressure in the line under all demand conditions.

Fisher regulating equipment handles all pressure extremes safely and positively. Fisher is your one source for all town border station gas regulators whether the need is to cut from 1500 or 150 psi. Fisher has exactly the regulator designed for the job. Check the selection below.

1. **TYPE 657-L FREE-FLO METER RUN SHUT-OFF VALVE:** Developed especially for cutting in and out multiple meter service. Provides 100% tight shut-off. Allows full flow with negligible pressure drop with the valve in open position. Can be used for two or more meters where large and variable gas loads are to be measured.

2. **"KIXCEL" ELECTRICAL DRIVE UNIT:** "Kixcel" is the unit for changing the setting of your town border regulator from remote control station by radio or telephone circuit. Can be supplied for remote setting Series 880, 298T or Wizard high pressure regulators.

3. **TYPE 630 "BIG JOE" GAS REGULATOR:** Ever popular "Big Joe" frequently used on small border stations and service taps from high pressure transmission lines. Suitable for inlet pressures up to 1500 psi and for reduced pressures from 3 to 200 psi.

4. **TYPE 282 DIA-GRID FOR PRESSURE RELIEF OR REDUCING SERVICE:** Using an expansible element, the pilot loaded Dia-Grid ideally suited for town border stations requiring positive shut-off and large capacity. Can be supplied with pilot loader for relief service for pressures up to 750 psi and with pilot loader for pressure reducing service with inlet up to 500 psi and reduced pressure up to 200 psi.

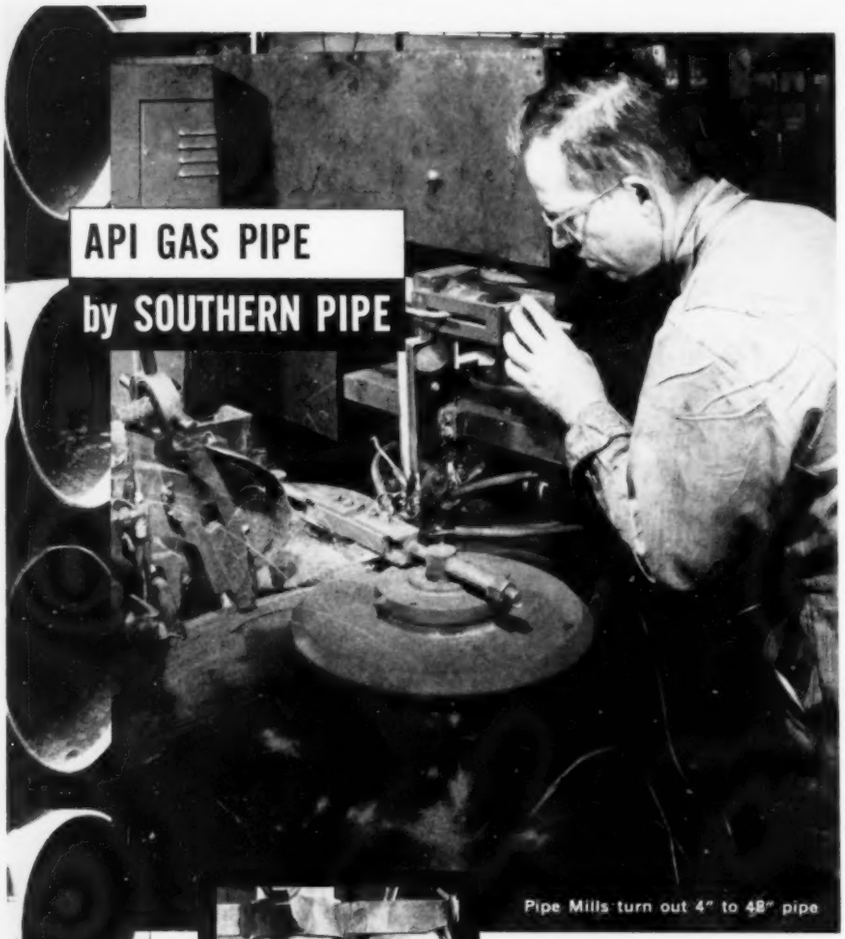
5. **WIZARD II HIGH PRESSURE GAS REGULATOR:** Widely used for first stage reduction because of its flexibility and wide range of adjustments. Available for remote mounting or on yoke of control valve. Wide proportional band adjustment. Can be supplied with reset response. Can be supplied with spring closed or spring opened control valve.

6. **TYPE 885-1 HIGH PRESSURE GAS REGULATOR:** Designed to handle uncommonly rough jobs that involve high pressures up to 1000 psi, reduced pressures up to 450 psi. Oil dash pots prevent inner valve vibration or jump while operating in a high pressure, high capacity system.

7. **TYPE 880 HIGH PRESSURE GAS REGULATOR:** Handles inlet pressures up to 600 psi. Designed to deliver outlet pressures ranging from 1 psi to 250 psi. High tensile diaphragm casing withstands high emergency loading pressures up to 300 psi.

FISHER® Controls
SINCE 1880

FISHER GOVERNOR COMPANY
Marshalltown, Iowa / Woodstock, Ontario / London, England
CONTINENTAL EQUIPMENT CO. DIVISION, Coraopolis, Pennsylvania



Pipe Mills turn out 4" to 48" pipe

Compression test—typical of Southern Pipe's quality control

**NOW—
HIGH-FREQUENCY
WELDING PRODUCES
BETTER GAS PIPE**

Southern Pipe was the **first producer** of API approved gas pipe, and API quality thin-wall gas pipe, fabricated by means of Thermotool HIGH-FREQUENCY welding. And, **only** Southern Pipe can give you the better welds that are produced under HIGH-FREQUENCY welding.

Here's what Southern Pipe offers gas pipe users: (1) Fully normalized weld; (2) A weld stronger than the pipe itself; (3) Only minor metallurgical change in material adjacent to weld; (4) Thin-wall high strength at less cost per foot.

Write for Stanford Research Institutes' Report on HIGH-FREQUENCY welding

Southern Pipe
DIVISION OF U.S. INDUSTRIES, INC.
P.O. Box C • Azusa, Calif. • CUmberland 3-7111—EDgewood 7-1221

C. Horace Sanders Named District Manager

C. Horace Sanders has been named southwest district manager for Cooper-Bessemer Corporation. He succeeds A. A. Burrell, who recently retired.

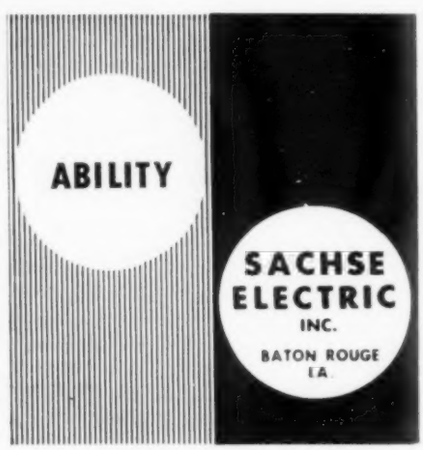
Sanders has been with Cooper-Bessemer since 1927. He became assistant southwest district manager in 1946. Burrell vacates the post of vice president and district sales manager. He had been with the company since 1925.

J. D. Mattimore Chosen Vice President By Tube Turns

Tube Turns Division of Chemetron Corportation announces the appointment of J. D. Mattimore as vice president for products engineering and research.

J. D. Mattimore

Mattimore has been director of Tube Turns' product engineering and research department and will continue to supervise its work. He has been associated with the firm since 1942, following 12 years of service with Walworth Company. Mattimore was assistant director of research before his appointment as director of the department.



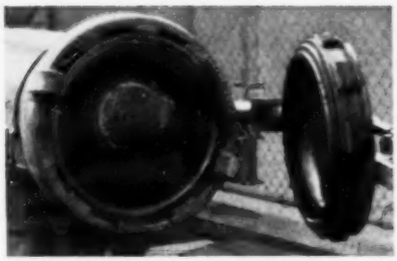
CLASSIFIED ADVERTISING

SENIOR COMMUNICATIONS ENGINEER

Major pipe line company with offices in Midwest has need for qualified engineer experienced in both microwave and wire line communications. Must be familiar with all types of communication and related equipment and capable of design, cost estimating, and preparation of economic studies on new facilities or revision or expansion of existing facilities. Must be capable of writing and interpreting specifications for units of communication equipment or for communications system. Required to supervise communications study section, including dealing with other company groups or outside groups such as equipment suppliers or partners in jointly-owned systems.

Write, giving resume of education, experience, and qualifications, including picture and telephone number.

Box 52-P
PIPE LINE INDUSTRY
Houston, Texas



Maloney PIPE LINE SPHERES IN NATURAL GAS PIPE LINES

HYDROSTATIC TESTING • WATER, SAND, AND DISTILLATE REMOVAL

EFFICIENT — Wiping action superior to conventional scraper cups. Can be used to head the water column in hydrostatic testing and to purge the line after testing is complete. Eliminates dew point problems. In gas gathering systems the Sphere will flush sand out of lines along with distillate and water. Sphere will follow flow through sharp bends, tees, etc., without hanging up.

ECONOMICAL — The Maloney Pipe Line Sphere can be used, with full effectiveness, until literally worn out. The life of the Sphere is several times that of a set of scraper cups, and labor in handling is reduced to a minimum. Due to the consistent rate of travel in the line, pigging time can be cut as much as one-half and requires a smaller crew to conduct the pigging operation.

SAFE — The Pipe Line Spheres require substantially lower pressure differential to drive, even through severely obstructed lines. The sphere will ride over many obstructions that would stop a conventional pig avoiding excessive line pressures to dislodge.

Sizes 2 through 24 inch available. Larger sizes are being designed.

"Something From the Irishman"

F. H. Maloney COMPANY

CHICAGO • LOS ANGELES • PITTSBURGH • TULSA
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Practical Books For Your Pipe Line Library

PIPE LINE CORROSION AND CATHODIC PROTECTION

A Field Manual

By Marshall E. Parker

This book is designed as a practical field manual. It provides workable methods that can save you valuable time and effort in obtaining interpretive field data.

CONTENTS (Condensed). Soil Resistivity Surveys: Soil resistivity units, two- and four-terminal resistivity determination, locating "hot spots" on bare lines. Pipe-to-Soil Potentials: Electrodes, voltmeters, slide-wire potentiometers, potentiometer-voltmeter, vacuum-tube voltmeter, electrode placement, surface potential, survey for corrosion. Line currents: calibration of test section, stray current studies, cathodic protection tests. Current Requirement Surveys: Principles of current measurement test, field procedure, temporary ground beds. Rectifier System for Coated Lines: design principles, attenuation curves, design procedure, the economic balance. Ground Bed Design and Installation: disturbing factors, field modification, installation methods. Magnesium Anodes on Coated Lines: when and where to use magnesium anodes, general design system, installation procedure, polarization and final adjustment. Hot Spot Detection: locating hot spots, anode selection and spacing, installation, supervision and control. Stray Current Electrolysis: detection of stray current, remedial measures. Interference in Cathodic Protection: design, crossing bonds, auxiliary drainage. Operation and Maintenance: failures in rectifier-ground bed and magnesium anode systems, monitor systems. Coating Inspection and Testing: construction detection, when and how to "jeep," evaluation of coating in place. Appendix: Fundamentals of Underground Corrosion, Basic Principles of Cathodic Protection, Tables and Properties of Metals, Attenuation Equations. Index.

1954, 108 pages, illustrated . . . . . Price $3.00

PETROLEUM DICTIONARY

By Hollis P. Porter

A valuable book for field and office. Beginners in the oil industry (young technicals, secretarial and clerical) and veterans in the business will find the Petroleum Dictionary to be of real interest and value to them. It is convenient to use, easy-to-read and understand. No other work of a similar nature compares with its thoroughness and dependability. It will be a valuable adjunt to the libraries of executives, engineers, students of the oil industry . . . in fact anyone who is in anyway connected with or interested in the petroleum industry.

1948, 326 pages . . . . . Price $6.00

WELDING ENGINEERING

By Boniface E. Rossi

A concise, technically accurate book on welding processes, weldability of metals, design and fabrication techniques and testing and inspection of welds. Contents include: Survey of welding processes and their basic principles, Gas welding, electric arc and its welding applications, submerged arc welding, deposition rates, welding costs, standard welding symbols and their use.

1954, 786 pages, illustrated . . . . . Price $9.00

Order from: Book Dept.
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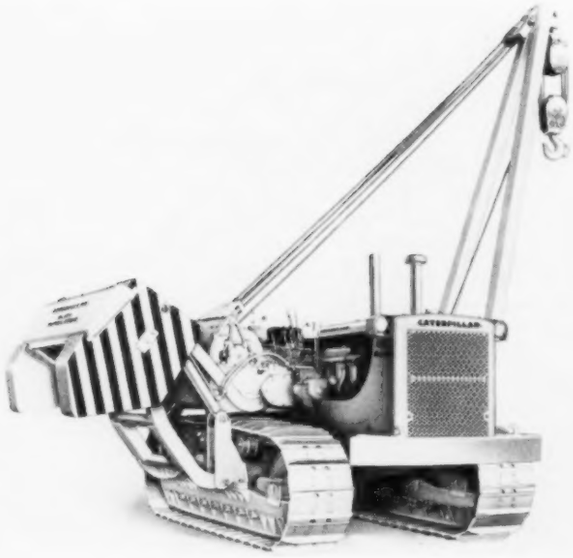
What's New in EQUIPMENT

To receive more information on all new equipment articles use Readers' Service Card, last page of this issue.



Caterpillar Announces New Tractor Series

Introduction of two new tractors, an improved pipelayer, and a complete line of tools to match these machines has been announced by Caterpillar Tractor Co. Featuring increased weight, horsepower and productive ability, Caterpillar's series H D8 tractors are available as direct drive or torque converter tractors. Three model blades, straight, angle, and "U" dozer, have been designed for the bulldozer series. Also a new No. 8 ripper, incorporating a "5-position" clevis and tooth is available for the D8 series.

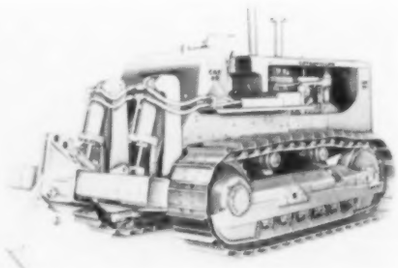
The Series H No. 583 pipelayer shows an increase in flywheel horsepower to 225 compared with 191 on Series E. Lifting capacity, at 4-foot overhang, has been increased to 137,000 pounds. Total weight of the machine is 83,840 pounds; the 583 has a maximum speed of 6.4 mph.

Main feature of the pipelayer is the incorporation of a turbocharger; an exhaust-driven turbine which increases combustion efficiency. Other features include its dry-type air cleaner for better intake air filtering; use of two large-capacity filters; torque converter with a multiplication of 4.00:1; hydraulically actuated steering clutches; and pressure-lubrication of the entire power train with completely filtered oil. Engine type oil is used to lubricate and cool the transmission, bevel gears and steering clutches. Compartments housing these power train components are interconnected, forming a common oil sump, which is served by a two-section pump.

The 583 undercarriage includes an improved box section hard bar to support the front of the tractor and an inner rear track guiding guard. Lifetime lubricated track and carrier rollers and idlers require no lubrication during their service life, made possible by new floating-ring seals and rubber rings.

The new D8 tractors are 9 inches longer and 5 inches higher than their predecessors; gage has been increased from 28 inches to 84 and length of track ground contact has been boosted from 111½ to $114^{11}/_{16}$ inches. Flywheel horsepower has been raised to 225; drawbar horsepower is increased to 180 and forward speed is upped to 6.3 mph. The transmission on direct drive models is directly reversing in all six speeds and the transmission has four shifts instead of three.

The new 8S bulldozer, which is 9½ inches longer, features increased blade rigidity and a standard two-piece cutting edge. The 8A model includes a two-piece C-frame which can be assembled or disassembled according to size restrictions and an 18-inch longer blade. The 8U model, with an 18-inch increase in length and 6¾-inch increase in height incorporates operating and servicing features of the 8A and 8S models. Bore of the No. 8 ripper has been increased from 7¼-inches to 8¼-inches to provide lower working hydraulic pressures and greater reserve capacity.



No. 8 Ripper on D8 Tractor

(This item supplements Caterpillar Tractor Company data on pages 67-69 of the Pipe Line Composite Catalog, 1st Edition.)

For more data, circle **No. E1** on Readers' Service Card, last page this issue.

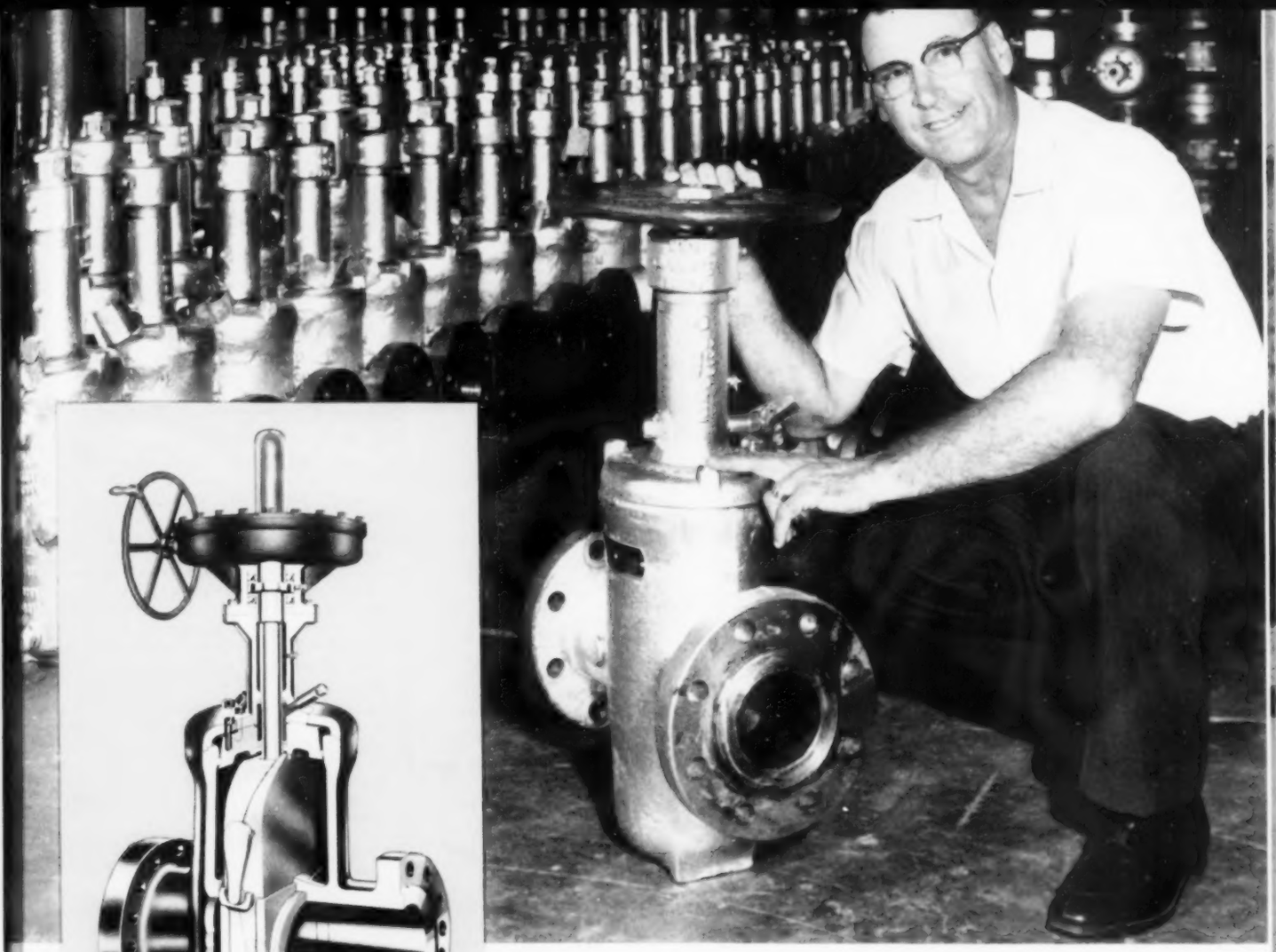
Heavy End Aluminum Pipe

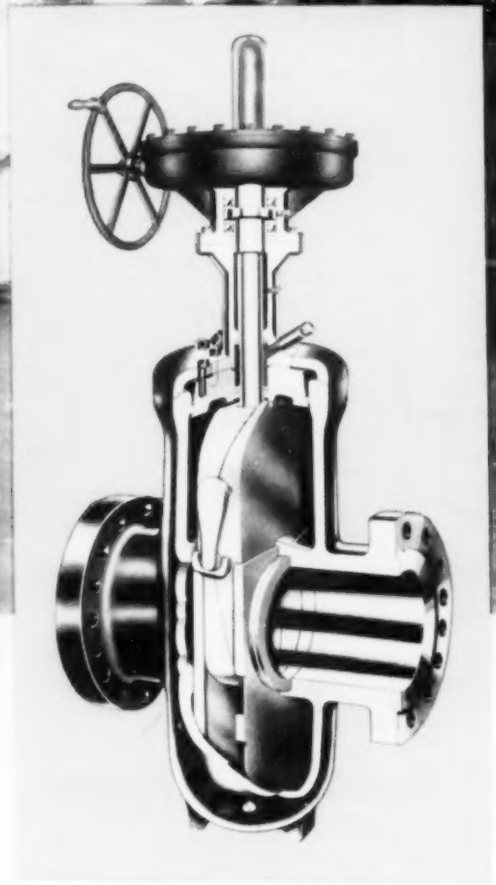
Heavy end aluminum pipe has been introduced by Reynolds Metals Company. Produced by an extrusion method, Reynolds puts metal where it is needed for strength in the pipe eliminating excess thickness in the pipe body. The new pipe is offered in sizes equivalent to the company's Schedule 40 and 80 sizes. With the flexible extrusion method a wide range of diameters and wall thicknesses can be achieved.

For more data, circle **No. E2** on Readers' Service Card, last page this issue.

Tank Thermometers

W. H. Curtin & Company announces the production of its tank thermometers with "Everlast" fused-in gradations. Gradations are etched in the glass and filled with a special pigment. Another process fuses pigment into the glass and gradations become a permanent part of the





Leverlock* Gate Valves — A W-K-M Exclusive

W-K-M Pipeline Valves open **free** and close **easy** against any pressure within their rating. An exclusive centralizing mechanism—found only in W-K-M Leverlock Valves—positively holds the gate and segment assembly in a retracted position so that it will move freely between the seats when the valve is being opened or closed.

When the gate and segment reach the fully open or fully closed position—and only then—the centralizing mechanism releases to permit the gate and segment to expand and seat tightly against the upstream and downstream seats.

On Hand

Order 2-inch through 12-inch sizes from your supply store. Larger sizes to 34-inch available on special order from factory. Sizes 6-inch and larger are Leverlock Valves. ASA 300 pounds to ASA 1500 pounds.

*Trademark of ACF Industries, Inc.

The W-K-M® Through-Conduit Gate Valve is your valve

W-K-M's creative engineering designed this valve to solve *your* pipeline valve problems. It has been produced to meet your specifications for strength, long life and economy. Before it reaches you, it will have undergone rigorous and thorough testing.

That's why field men recommend the W-K-M Through-Conduit Gate Valve, why engineers specify its use. Its reputation inspires confidence—its dependability has been proved in service throughout the world.

It's *your* valve; specify and use it.

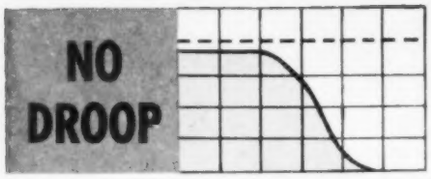
A Product of W-K-M's *Creative Engineering*

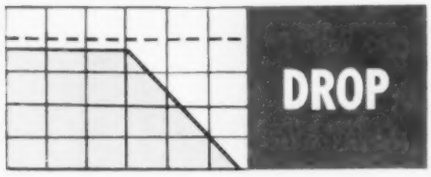
WRITE FOR CATALOG 300

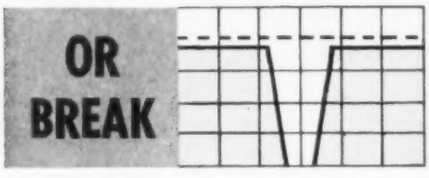
W-K-M

DIVISION OF ACF INDUSTRIES
INCORPORATED
P. O. BOX 2117, HOUSTON, TEXAS
Export Office: 45 ROCKEFELLER PLAZA, NEW YORK, N. Y.

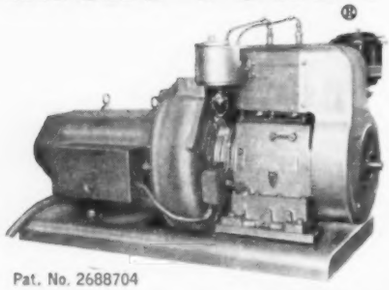
5818







in Communications with U. S. MICRO-POWER®



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Micro-Power Units are available in 1500, 3000, 5000 and 10000 watt capacities. For complete information, specifications, and demonstration, write . . .

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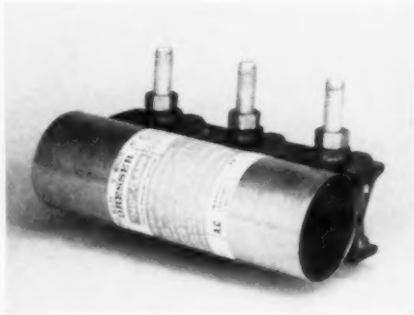
thermometer. The easy to read product is placed in a wooden case and resists warping and cracking.

For more data, circle **No. E3** on Readers' Service Card, last page this issue.

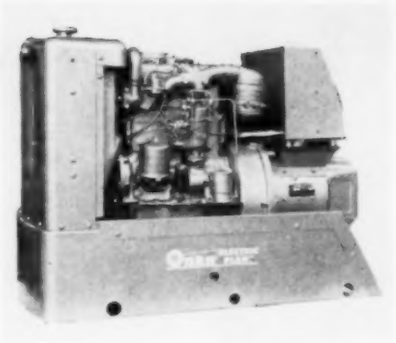


Repair Clamp

Dresser Manufacturing Division announces a new small diameter pipe repair clamp made of stainless steel and malleable iron lugs. Easy to install, the clamps can be used for repairing full breaks or holes in asbestos-cement and cast iron water lines in oil fields, water and sewage systems, plants and factories. The "360" also can be used as a coupling.

The small clamps utilize efficient finger design gasket to provide positive sealing over a greater range of adjustability. Cemented in place, these gaskets conform to the pipe, cushioning it from shock and movement to help prevent future pipe breaks.

For more data, circle **No. E4** on Readers' Service Card, last page this issue.



Diesel Generating Plants

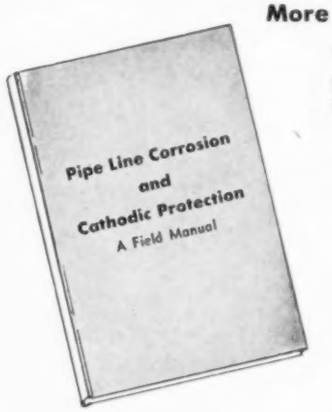
D. W. Onan & Sons Inc. announces a new series of water-cooled, diesel-driven, electric generating plants. Series DZB generating plants are available in either 10,000 as shown or 15,000 watt AC size ranges and in all standard 60 or 50 cycle voltages to 460 volts. These self-contained sets will provide full-rated electric power for both primary power applications for contractors, oil field installations, anywhere a continuous source of electricity is needed. The unit is especially desirable for station or field application.

Prime mover for the electric plants is the heavy-duty, 3-cylinder, 37 hp, at 1800 rpm, Hercules D. D. 149 engine. Features include a direct-injection pump with a built-in fuel transfer pump; replaceable fuel filter cartridge, hand priming pump, oil bath air cleaner and variable-speed, mechanical governor.

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

More comments on this new Handbook:

". . . a most practical on-the-job manual for men concerned with pipe line corrosion. We are ordering copies for each of our district engineers."



Pipe Line Corrosion and Cathodic Protection

By MARSHALL E. PARKER

This Handbook, written by Marshall E. Parker, consultant, is designed as a practical field manual. It is a 108-page pocket-size volume printed first as a popular series in WORLD OIL. The Handbook is illustrated with many charts and drawings and is completely indexed by subjects.

It presents comprehensive data on Soil Resistivity Surveys, Potential Surveys, Line Currents, Current Requirements, Rectifier Systems, Ground Bed Design, Magnesium Anodes, Stray Current Electrolysis, Interference in Protective Systems, Operations and Maintenance, and Coating Protection and Testing.

An appendix has been added of technical data on Underground Corrosion, Basic Principles of Cathodic Protection, Properties of Metals and Attenuation Equations. Order copies of this practical Field Manual now for each of your field men. Price $3.

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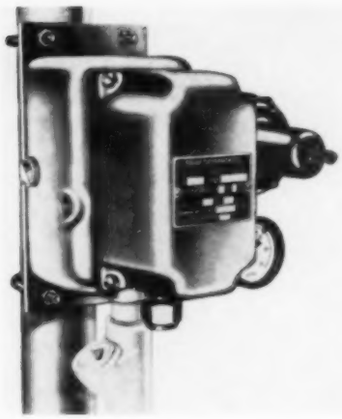

Transducer

Fisher Governor Company has presented a type 543 electro-pneumatic transducer to operate standard pneumatic control valve and electrical control loop.

The transducer utilizes a high capacity relay to produce a pneumatic output pressure that is proportional to a DC milliampere input signal. This allows the use of fast electrical transmission in conjunction with dependable and inexpensive pneumatic valve actuators. It is suitable for all input signals from 1 to 5 ma through 10 to 50 ma, and has standard pneumatic output ranges from 3 to 15 psi through 10 to 50 psi.

For more data, circle **No. E6** on Readers' Service Card, last page this issue.

Interface Tank Gage

Water interface as well as product levels can be measured with Gilbarco Electronic tank gages now being manufactured by Gilbert & Barker Mfg. Company. Both water interface and product level measurements are made with the same basic elements. Gages measure by a sensing element suspended in the tank. This element is a ¼-length antenna which just touches the product surface. Radio frequency signals of minute amplitudes are transmitted

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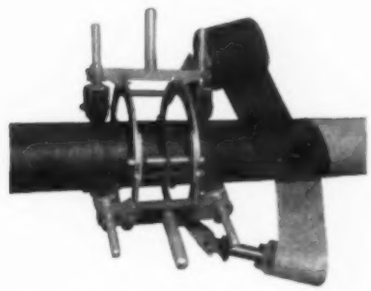
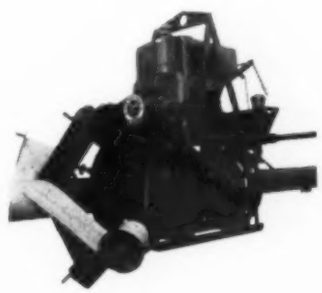


The MYOCO Tapemaster can use four arms to give any combination of tape and kraft or felt. Six various size machines available for ½" through 36" pipe; small machines use tape from ½" width through 9", large machines use 9" through 18" tape.



MYOCO Model OW Power Driven Cleaning and Taping machine combines two operations for increased speed of operations with less equipment. Line travel machines are available to handle pipe sizes 3" to 6", 6" to 12", and 14" to 20". A Wisconsin Model Vg4D V-type 4-cylinder heavy-duty air cooled engine, combined with the design and engineering features of this machine, guarantees uninterrupted service.

When you use MYOCO pipeline equipment, you quickly find that servicemen are experienced and available twenty-four hours a day, with fast transportation available to serve you in any way; efficient equipment operation is assured by periodical checks; and if possible, parts and supplies are shipped the same day ordered.

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Toronto 5, Ontario, Canada, Tel. WA 2-9444

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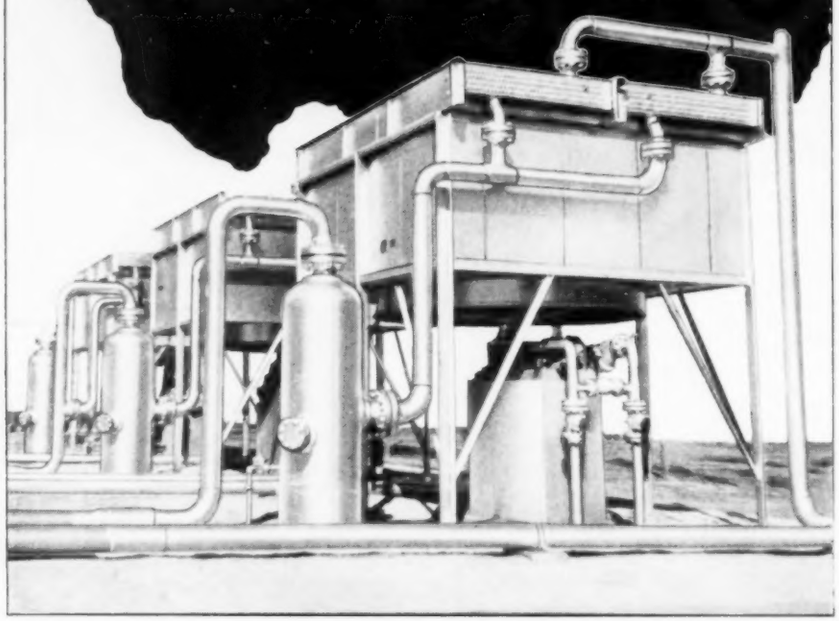
do double duty cooling at TEXAS GAS STORAGE STATION



Pictured are three Young Radiator Company HC-1210 coolers handling Gas Inter-Cooling at the Tri Cities Station near Athens, Texas

The Lone Star Gas Company utilizes six HC atmospheric coolers by Young at their gas storage station near Athens, Texas. Three of these units cool Engine Jacket Water and Lube Oil on three 1350 hp Cooper-Bessemer 2-cycle Engines. The other three units do the Gas Inter-Cooling, and are designed to handle a total of 48 MMCFD to 78 MMCFD under varying conditions... up to 1500 psi working pressures. Young HC Units are built for rugged service. Their versatility means you get job-matched performance, according to the requirement of the heat transfer problem. Young Design and Engineering experience in the Oil Field, Petro-Chemical and Chemical Processing industries is yours for the asking. Call or write your nearest Young representative about your present or future Heat Transfer problems. No obligation of course.

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1. Central Station Equipment Co. Tucson, Arizona
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3. Jones and Laughlin Bradford, Pennsylvania
4. J. R. Meek Company Tulsa, Oklahoma, Houston, Texas
5. Frank Walz Denver, Colorado
6. Dutton-Williams Bros. Ltd. Calgary, Alberta, Canada
7. H. J. Young Muskegon, Mich.

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Young RADIATOR COMPANY
RACINE, WISCONSIN

Creative HEAT TRANSFER ENGINEERS

Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Mattoon, Illinois

to the antenna. Against a fixed or constant signal are balanced detected or variable signals. Rise or fall of the product level results in immediate signal imbalance; this causes the sensing element to move either up or down. For the water interface measuring, the same sensing element which ordinarily tracks product surface is made to measure water bottom. For this purpose a switch on the servo-control mechanism at the base of the tank is operated. When turned on, the sensing element moves below product level and continues sounding through the product until the surface of the water bottom is reached.

For more data, circle **No. E7** on Readers' Service Card, last page this issue.

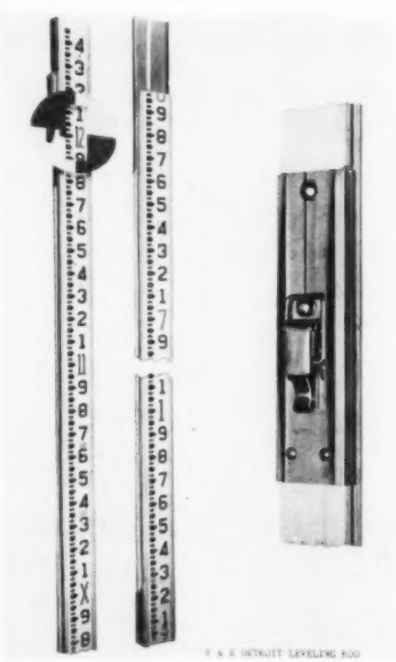
Closed Circuit TV

General Electric Company has introduced a new line of automatic closed-circuit television cameras which will automatically adjust to changing light levels.

Designated the TE-6-B and TG-2-B, the cameras utilize a regulated target voltage to maintain a uniform output signal level over light changes greater than 150 to 1.

(This item supplements General Electric Company data on pages 181-188 of the Pipe Line Composite Catalog, 1st Edition.)

For more data, circle **No. E8** on Readers' Service Card, last page this issue.



K & E DETROIT LEVELING ROD

Leveling Rod

Quick to operate, completely rigid and easily portable describes the three section Detroit leveling rod announced by Keuffel & Esser Co.

A latch type clamp on a steel brace pulls the rod sections together in metal-to-metal contact uniting the sections in virtually one continuous piece. The rod's three sections can be carried in a partitioned, mildew resistant bag, 4½-feet long. It can be used in three lengths, 4-, 8-, or 12½-foot lengths. Designed to be easier to read at longer distances, the rod features "skyline graduations," minimizing the probability of error.

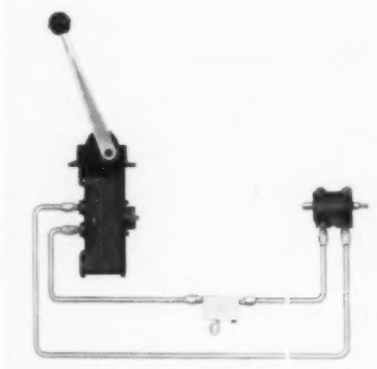
For more data, circle **No. E9** on Readers' Service Card, last page this issue.

Cranes and Excavators

Insley Manufacturing Corporation has introduced new models of heavy construction equipment consisting of the Insley 45-ton truck crane and "M" and "WT" series of cranes and excavators. Models in the WT series include a 22½-ton crawler crane and 25 and 30-ton truck cranes; "M" series includes a 15-ton crawler crane, a 20-ton lorry crane and ¾-yard excavator.

The new additions give Insley a complete line of excavators and cranes from 5 to 45 tons capacity or ½- through 1¼-cubic yards.

For more data, circle **No. E10** on Readers' Service Card, last page this issue.



Remote Control Unit

A self-contained, manually operated hydraulic system manufactured by The Hydronic Corporation can be applied for remote control of valves in compressor stations, gasoline plants and oil field operations.

The system consists of a master manual control hydraulically coupled to a movement duplicator or slave cylinder. The cylinder is available with a lever-type arm for transmitting motion through an arc, or with a straight-motion, push-pull, piston-type arm. Lever-type arm transmits 500-inch pounds of full hydraulic output in either direction through a 114° arc. The straight-motion slave arm delivers 1000-inch pounds of thrust in either direction through a 1-inch stroke.

For more data, circle **No. E11** on Readers' Service Card, last page this issue.

Six KMC Band

General Electric's Communication Products department is broadening its line of microwave products with a series of equipment in 6 KMC band. Adding this line to the 2 KMC line enables microwave users to combine the advantages of equipment operating in both bands for their system planning.

General Electric will now offer both Time Division and Frequency Division multiplexing with its 6 KMC products.

(This item supplements General Electric Company data on pages 181-183 of the Pipe Line Composite Catalog, 1st Edition.)

For more data, circle **No. E12** on Readers' Service Card, last page this issue.

HOT DOPE
FROM
MYOCO
KETTLES

Dope stays hot and properly mixed when you use a MYOCO asphalt kettle. Completely insulated, it provides guaranteed heat retention, assuring almost no temperature differential of filler between top and bottom. Coking is unnecessary.

Settling is prevented through two-way agitation—a mechanically driven propeller and hydraulic bottom sweep.

Additional time, labor and money savings result from the MYOCO asphalt kettle's design, which eliminates the need for over-width highway transportation permit.

Safety is assured, since fuel tank is installed inside of frame and protected from firebox by bulkhead.

The MYOCO asphalt kettle is available in 10, 27, 30 barrel sizes, powered by a Wisconsin engine or its electric equivalent, and with Athey tracks, steel skids, or fitted for stationary use. Blower or mailbox type burners are optional.

Call or write:

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Quoted from Mr. Dillard Stokes' Column, Shreveport Journal, Oct 13, 1958..
"President Jefferson feared the justices some day would do what they now are accused of. A few months before he died President Jefferson wrote: 'There is no danger I apprehend so much as the consolidation of our government by the noiseless, and therefore unalarming, instrumentality of the Supreme Court'."

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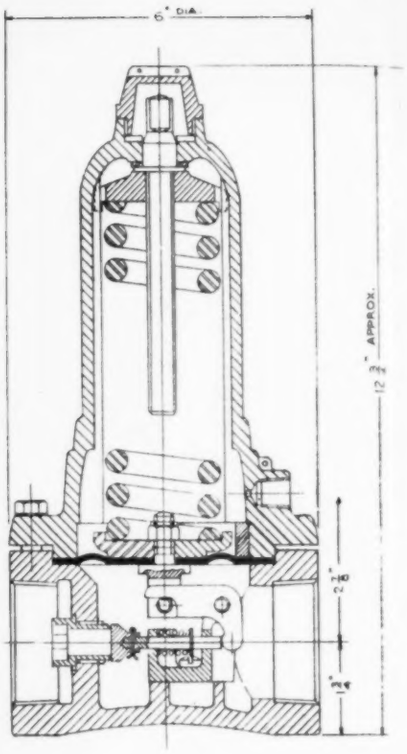


Field Regulator

A new 2-inch, high-pressure field regulator has been introduced by Rockwell Manufacturing Company. The regulators are particularly useful along isolated gas transmission lines where industrial and domestic consumers requiring small volume service must tap the lines directly. The simple, light-weight regulators are designed to handle the primary cuts in pressure.

The unit has a working pressure of 1500 psi—it will withstand pressures on the outlet side up to this figure without damages. It also offers convenience of interchangeable orifices and springs to provide outlet pressures ranging from 5 to 400 psi. Inlet pressure ranges from 10 to 1500 psi.

For more data, circle **No. E13** on Readers' Service Card, last page this issue.

Editorial Index Now Available

The Editorial Index is now at the printers and soon will be ready for distribution. The 1958 Editorial Index provides a time-saving entry into all 12 issues of PIPE LINE INDUSTRY published in 1958.

Bound in a handy pamphlet form for easy accessibility, the Editorial Index lists each and every article and its author. To get a copy, write Librarian, Gulf Publishing Company, P. O. Box 2608, Houston 1, Texas. Or, if you prefer, check the square provided on the blue Reader's Service Card at the back of this and every issue of PIPE LINE INDUSTRY.

Be assured of getting your copy by ordering your Editorial Index now. The supply is limited.

New Equipment Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card.

Mechanical Shaft Seal

Syntron Company announces a catalog on mechanical seals which stop the leakage of gas and liquids from around the rotating shafts of pumps, compressors, mixers, etc. and eliminate adjusting, repacking, and other maintenance.

The four-page bulletin contains illustrations, complete description data and specifications for mechanical shaft seals in a range of sizes for shaft diameters from ¼ inch to 3 5/16 inches. One page is devoted to custom-built roll neck seals which provide two-way seal for keeping lubricant in and water out of roll necks of work and back-up rolls in strip, tempering and other rolling mills.

To get a copy, circle **No. E14** on Readers' Service Card, last page this issue.

Fittings and Flanges

Complete dimensional data on the full line of Tube-Turn stainless steel welding fittings and flanges is published in a revised catalog from Tube-Turns.

The 54-page booklet contains updated technical data for allowable S-values, allowable working pressures of fittings, pressure-temperature ratings of flanges and corrosion resistance. Corrections have been made to reflect recent code changes and to conform with new code interpretations for types 304L and 316L stainless steel.

To get a copy, circle **No. E15** on Readers' Service Card, last page this issue.

Switchgear

A new bulletin describing in detail its line of 4160-volt metalclad switchgear has been released by I-T-E Circuit Breaker Company. The bulletin covers the complete line of indoor, and standard walk-in outdoor type equipment, with ratings through 3000 amperes continuous-current and 350-mva interrupting capacities.

The outdoor walk-in switchgear is described in a separate section. The two-color, 24-page booklet is illustrated with photographs, sketches, diagrams and drawings and includes charts and tables for detailed listings.

To get a copy, circle **No. E16** on Readers' Service Card, last page this issue.

Automatic Controls

Southwestern Industrial Electronics Co. has published a new control division book titled "Control . . . the answer to increased pipe line profits."

The book contains chapters pertaining to liquid pipe line controls, gas pipe line controls and SIE's automatic pipe line control equipment.

The 30-page edition is illustrated with photographs and drawings.

To get a copy, circle **No. E17** on Readers' Service Card, last page this issue.

Cost Record Book

Caterpillar Tractor Co. has prepared a special 24-page monthly time and cost record book. Twelve sets of pages are included on which to record, day by day, each month's individual machine expenses for an entire year. At end of the record section is an annual summary sheet where the totals for each month can be entered to obtain annual cost figures.

Spaces are provided for recording both the quantity and cost of diesel fuel, gasoline, lubricating oil, grease, filters, hydraulic oil, repair labor, and operator's time. Additional spaces allow room for transportation, miscellaneous, repair items, and type of work costs.

To get a copy, circle **No. E18** on Readers' Service Card, last page this issue.

Air Compressors

Le Roi Division announces a new four-color, 12-page bulletin describing Westinghouse unit type air compressors. It describes G single-stage, YS single-stage, and YC two-stage compressors ranging in size from ½ to 15 horsepower.

Photographs are used to illustrate the three different models of compressors which feature low oil level protection, enclosed crankcase, controlled pressure lubrication, and thermal overload protection.

To get a copy, circle **No. E19** on Readers' Service Card, last page this issue.

Integral Shaft Sheaves

Construction and operating features of vari-pitch integral shaft sheaves for low-cost stepless speed control in large machine drives are given in a new bulletin released by Allis-Chalmers.

Vari-pitch sheaves provide a wide range of speeds, infinite speed variations, and accurate speed control while the drive is in motion. The integral-shaft design permits mounting the sheave between two pillow blocks for rigid support and provides a flexibility to meet almost any drive requirement. The bulletin describes how integral shaft sheaves are available with lubrication systems designed and engineered to assure distribution of lubbricants to all moving parts.

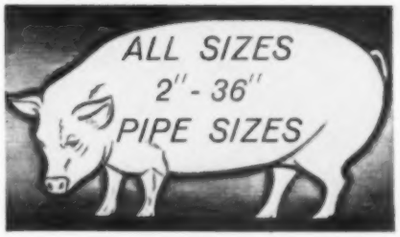
To get a copy, circle **No. E20** on Readers' Service Card, last page this issue.

Testing Engineers

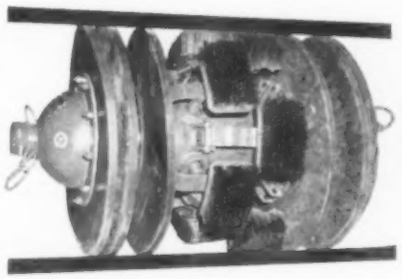
Southwestern Laboratories has published a four-page brochure presenting a brief outline of the company's services. Southwestern Laboratories engages in inspecting, sampling and testing steel pipe, X-Ray and gamma ray equipment, welder qualification equipment, field equipment for pipe lines, ultrasonic thickness gaging and metallurgical studies.

To get a copy, circle **No. E21** on Readers' Service Card, last page this issue.

MYOCO PIPELINE PIGS



ANY COMBINATION ALWAYS IN STOCK



MYOCO S-18 COLLAPSIBLE PIG

Especially designed for use on dual diameter lines and lines with small I. D. full opening valves within collapsible range. Sturdily built of lightweight aluminum castings with spring loaded brushes and collapsible rubber discs, the S-18 assures maximum cleaning action.

COLLAPSIBLE SIZES: 36" to 30", 30" to 24", 24" to 20" and 20" to 18".

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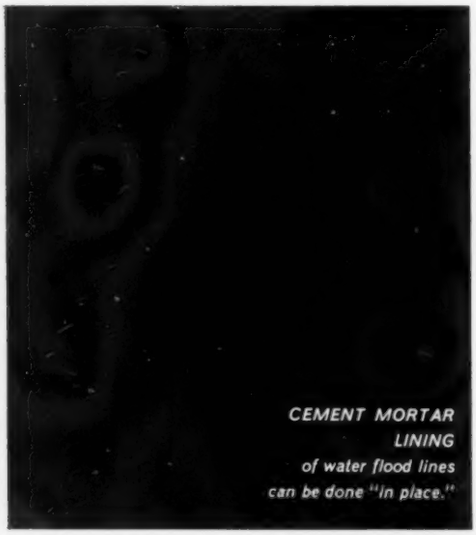
CORROSION IN WATER FLOOD PIPE LINES?

WATER FLOOD PIPE LINES can be protected from corrosive waters.



CEMENT MORTAR LINING of water flood lines can be done "in place."

WHERE CORROSIVE WATER is causing too frequent water line problems, Cement Mortar Lining is your answer.

And where raw water lines are being installed, Cement Mortar Linings are advisable, before the pipe goes in.

RESULT: Nuisance-free and trouble-free water pipe lines, for years.

PLUS SOMASTIC—for the best in exterior corrosion protection.

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also in Fort Worth
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Division of American Pipe and Construction Co.

Advertisers' Index

• Dot preceding name of advertiser indicates that detailed data on products and services of the firm will be found in current 2nd (1959) revision of The Pipe Line Catalog.

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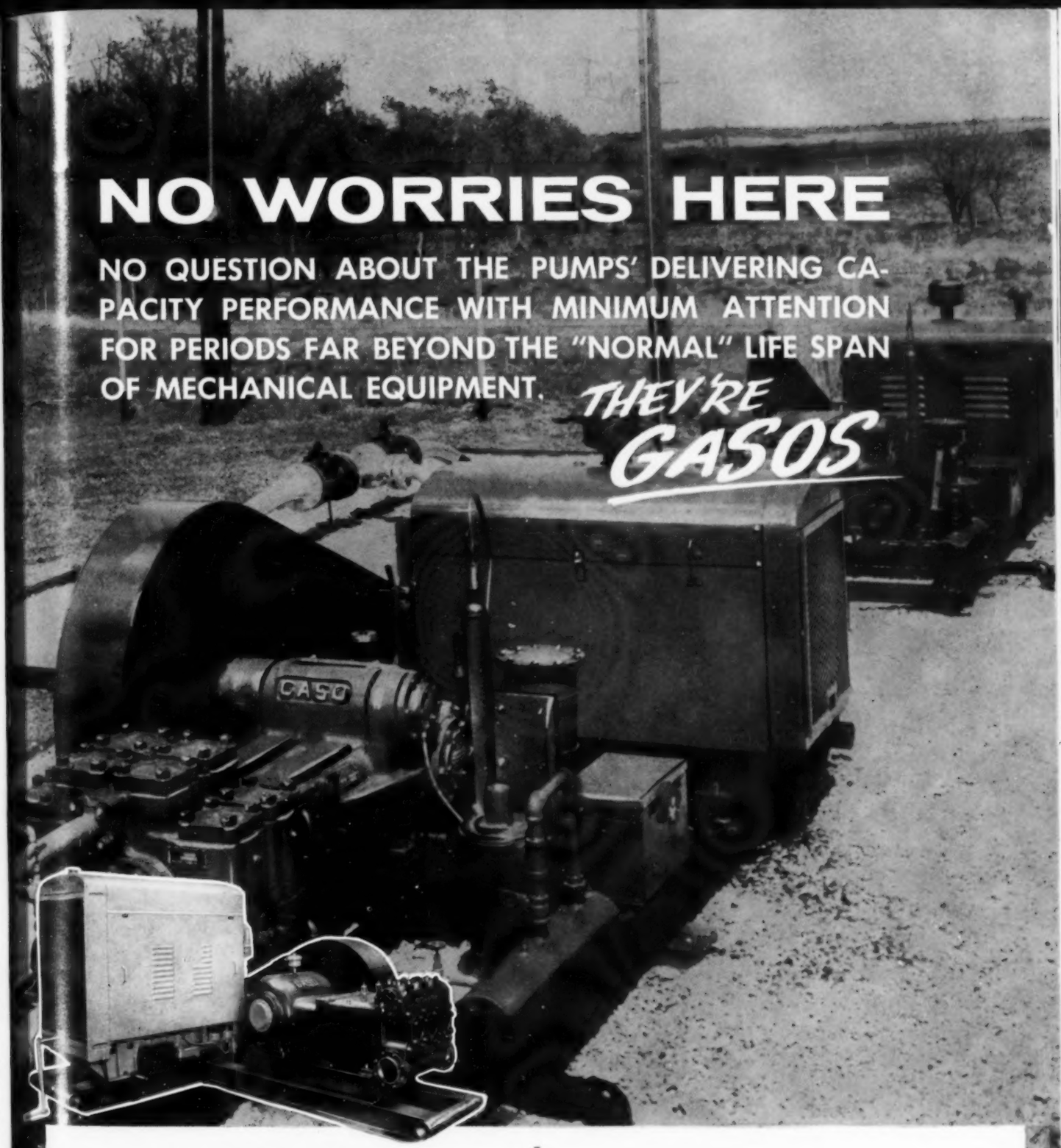

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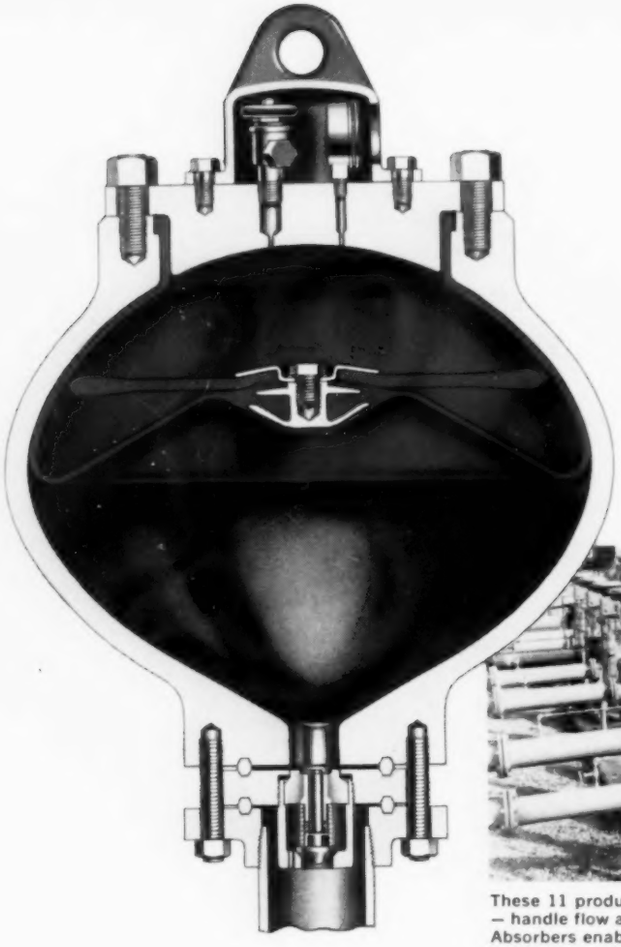

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